B.Tech. (Artificial Intelligence and Data Science)

CURRICULUM AND SYLLABUS HANDBOOK
Regulation 2023

Approved by Academic Council on 14.10.2024

2024-2025

Sri Eshwar College of Engineering
Coimbatore | Tamilnadu
An Autonomous Institution
Affiliated to Anna University, Chennai

Chairman - Board of Studies
Department of Artificial Intelligence and Data Science
Sri Eshwar College of Engineering (Autonomous)
Kinathukadavu, Coimbatore - 641202.

1.0 Vision, Mission and Core Values of the Institution

Vision

"To be recognized as a premier institution, grooming students into globally acknowledged engineering professionals."

Mission

We will achieve the mission by:

- ✓ Providing outcome and value-based engineering education
- ✓ Nurturing research and entrepreneurial culture
- ✓ Enabling students to be industry-ready and fulfil their career aspirations
- ✓ Grooming students through behavioural and leadership training programs
- ✓ Making students socially responsible

Core Values

The following core values of Sri Eshwar College of Engineering are closely aligned with its vision and mission, supporting the college's goal of developing well-rounded, globally capable, and socially responsible engineering professionals:

1. Pursuit of Excellence,
2. Problem Solving Mindset
3. Spirit of Collaboration
4. Culture of Innovation
5. Responsibility to Society

2.0 Vision and Mission of the Department of Artificial Intelligence and Data Science

Vision

"To build a conducive academic and research environment in the stream of Artificial Intelligence and Data Science for enabling global education, research and entrepreneurship."

Mission Statements

M1: Regularly assess and enhance the curriculum, integrating the latest advancements in artificial intelligence and data science to ensure relevance and global competitiveness.

M2: Provide state-of-the-art technological infrastructure & cutting-edge technologies conducive world-class research, innovation and quality learning experience for both faculty and students.

M3: Empower faculty of artificial intelligence and data science through continuous professional development, research support and global collaborations to deliver quality education aligned with international standards.

M4: Establish student-centric learning environment that empowers future innovators in the dynamic field of artificial intelligence through rigorous academic programs, cutting-edge research opportunities, and industry-aligned projects.

M5: Conduct outreach activities for the society that involve the use of artificial intelligence, data science and machine learning concepts to deal with societal issues.

3.0 B.Tech. (AI&DS) Program Educational Objectives (PEOs)

PEO1: To enable graduates to pursue higher education and research or have a successful career in industries associated with Artificial Intelligence and Data Science, or as entrepreneurs.

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PEO2: To demonstrate excellence in cutting-edge technologies of Artificial Intelligence and Data Science and solve problems in society.

PEO3: To exhibit professional ethics, involvement in team work in their profession and contributing to the advancement of society.

4.0 Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

5.0 B.Tech. (AI&DS) Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialisation as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyse complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

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PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyse and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to the economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Teamwork: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

6.0 B.Tech. (AI&DS) Program Specific Outcomes (PSOs)

PSO1: Apply the principles of artificial intelligence that require problem solving, inference, perception, knowledge representation, and learning.

PSO2: Demonstrate the ability to build innovative solutions from the data models, addressing the needs of Industry and society

7.0 B.Tech. (AI&DS) Program Curriculum

7.1. Curriculum Structure

The curriculum structure includes the following course categories:

Humanities and Social Sciences (HS): Technical English, Foreign Languages, Management & Engineering Ethics, and Engineering Economics.

Basic Sciences (BS): Mathematics, Physics, and Chemistry.

Engineering Sciences (ES): Materials Science, Workshop Practices, Drawing, and Fundamentals of Electrical, Electronics, Mechanical, and Computer Engineering.

Professional Core (PC): Courses specific to the chosen specialisation or branch.

Professional Electives (PE): Elective courses within the chosen specialisation (Vertical).

Open Electives (OE): Courses from other technical or emerging subject areas.

Project Work (PW): Projects involving Design Thinking (Product/Software Development Life Cycle), Innovative/Multidisciplinary Projects, Industry Projects, and other project work.

Employability Enhancement Courses (EM): Personality Development, Verbal and Soft Skills, Advanced Logical Thinking, and Industry or External Internships.

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Mandatory Courses (MC): Heritage of Tamils (**HSMC**), Tamils and Technology (**HSMC**), Environmental Science, and Universal Human Values.

Optional Courses (OC): NCC Credit Course Level I, NCC Credit Course Level II, NCC Credit Course Level III and Honours Courses.

Student Induction Program (SIP)

The Student Induction Programme (SIP) is an essential three-week orientation tailored for first-year undergraduate students enrolled in BE/B.Tech programs. Held annually, this programme is designed to facilitate a smooth transition from secondary education to collegiate life, ensuring that students effectively integrate into both the academic and social environments of the institution.

Program Components

- ✓ Universal Human Values
- ✓ Health
- ✓ Department Familiarization
- ✓ Interactive Lectures
- ✓ Proficiency Modules
- ✓ Local Visits
- ✓ Cultural Activities

The SIP plays a pivotal role in setting the stage for a successful and fulfilling college experience, providing students with the tools and support necessary for a smooth transition into their academic and social life

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7.2. B.Tech. (AI&DS) Curriculum

Outcome-Based Education (OBE) with Choice Based Credit System (CBCS).

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Semester I

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
-	-	Induction Program	-	-	-	-	-	-	-
1	U23MA201	Calculus for Engineers	BS	3	1	0	0	4	4
2	U23CS301	Problem Solving using C	ES	3	0	0	0	3	3
Theory cum Practical Courses									
3	U23HS181	Technical English	HS	2	0	2	0	4	3
4	U23CS381	Application Design and Development	ES	2	0	2	0	4	3
5	U23EC381	Electronics and Microprocessors	ES	3	0	2	0	5	4
Practical Courses									
6	U23CS351	Problem Solving using C Laboratory	ES	0	0	4	0	4	2
7	U23GE351	Engineering Practices Laboratory	ES	0	0	2	0	2	1
Professional Development Course									
8	U23EM751	Soft Skills	EM	0	0	2	0	2	1
Mandatory Course									
9	U23MC901	தமிழர்மரபு/ Heritage of Tamils	HSMC	1	0	0	0	1	1
Total				**14**	**1**	**14**	**0**	**29**	**22**

Semester II

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23MA203	Linear Algebra	BS	3	1	0	0	4	4
2	U23CS401	Data Structures	PC	3	0	0	0	3	3
3	U23PH201	Computational Physics	BS	3	0	0	0	3	3
4	U23CS402	Object Oriented Programming using C++	PC	3	0	0	0	3	3
	U23NCC01	NCC Credit Course Level I[#]	OC	2	0	0	0	2	2
Theory cum Practical Course									
5	U23HS5XX	Language Elective[*]	HS	2	0	2	0	4	3
				3	0	0	0	3	3
Theory cum Practical with Project Course									
6	U23AD481	Python for AI	ES	2	0	2	2	6	4
Practical Courses									
7	U23CS451	Data Structures Laboratory	PC	0	0	4	0	4	2
8	U23CS452	Object Oriented Programming using C++ Laboratory	PC	0	0	2	0	2	1
Professional Development Course									
9	U23EM752	Logical Thinking	EM	0	0	2	0	2	1
Mandatory Course									
10	U23MC902	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HSMC	1	0	0	0	1	1

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Total				**17**	**0**	**14**	**2**	**32**	**25**

*-U23HS581: Business English (2-0-2-0-3); U23HS501: Basic Japanese (3-0-0-0-3); U23HS502: Basic German (3-0-0-0-3); #-Offered only for NCC students

Semester III

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23MA204	Discrete Mathematics	BS	3	1	0	0	4	4
2	U23CS403	Design and Analysis of Algorithms	PC	3	0	0	0	3	3
3	U23CS404	Database Management Systems	PC	3	0	0	0	3	3
Theory cum Practical Course									
4	U23EC382	Digital Principles and Computer Organization	ES	3	0	2	0	5	4
Theory with Practical and Project Courses									
5	U23AD491	Data Science	PC	2	0	2	2	6	4
6	U23CS491	Java Programming	PC	2	0	2	2	6	4
Practical Courses									
7	U23CS453	Design and Analysis of Algorithms Laboratory	PC	0	0	4	0	4	2
8	U23CS454	Database Management Systems Laboratory	PC	0	0	2	0	2	1
Total				**16**	**1**	**12**	**4**	**33**	**25**

Semester IV

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23MA209	Probability and Statistics	BS	3	1	0	0	4	4
2	U23CB401	Operating Systems	PC	3	0	0	0	3	3
Theory cum Practical Courses									
3	U23AD482	Big Data Analytics	PC	2	0	2	0	4	3
4	U23AD483	Artificial Intelligence	PC	3	0	2	0	5	4
	U23NCC02	NCC Credit Course Level II[#]	OC	2	0	2	0	4	3[#]
Theory with Practical and Project Course									
5	U23CS492	Full Stack Development	PC	2	0	2	2	6	4
Practical Course									
6	U23CB451	Operating Systems Laboratory	PC	0	0	2	0	2	1
Professional Development Courses									
7	U23IADXX	Industry Oriented Course[$]	EM	0	0	2	0	2	1
8	U23EM753	Advanced Logical Thinking	EM	0	0	2	0	2	1
Project Work									

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
9	U23AD651	Project with Design Thinking (Product / Software Development Life Cycle)	PW	0	0	0	2	2	1
Mandatory Course									
10	U23MC903	Environmental Science	MC	1	0	0	0	1	NC
Total				**14**	**1**	**12**	**4**	**31**	**22**

$- IOC Structure: 1 0 0 0 1 / 0 0 2 0 1; #-Offered only for NCC students

Semester V

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23AD401	Artificial Intelligence and Robotics	PC	3	0	0	0	3	3
2	U23XXXX	Professional Elective I*	PE	3	0	0	0	3	3
Theory cum Practical Courses									
3	U23EC384	Computer Networks	ES	3	0	2	0	5	4
4	U23AD484	Data Visualisation & Exploration	PC	2	0	2	0	4	3
Theory with Practical and Project Courses									
5	U23AM491	Machine Learning	PC	2	0	2	2	6	4
6	U23AM494	Natural Language Processing	PC	2	0	2	2	6	4
Practical Course									
7	U23AD451	Artificial Intelligence and Robotics Laboratory	PC	0	0	2	0	2	1
Professional Development Course									
8	U23EM754	Summer Internship	EM	-	-	-	-	-	1
Mandatory Course									
9	U23MC904	Universal Human Values	MC	1	0	0	0	1	NC
Total				**16**	**0**	**10**	**4**	**30**	**23**

*- Electives Structure: 3 0 0 0 3 / 2 0 2 0 3;

Semester VI

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23AD403	Data and Information Security	PC	3	0	0	0	3	3
2	U23XXXXX	Professional Elective II*	PE	3	0	0	0	3	3
3	U23OXXXX	Open Elective I*	OE	3	0	0	0	3	3
Theory cum Practical Courses									
4	U23IT484	Cloud Computing Technologies	PC	2	0	2	0	4	3
5	U23EC383	Embedded Systems and IoT	PC	3	0	2	0	5	4
	U23NCC03	NCC Credit Course Level III#	OC	2	0	2	0	4	3#
Theory with Practical and Project Course									
6	U23AM492	Deep Learning for Computer Vision	PC	2	0	2	2	6	4
Project Work									

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
7	U23AD652	Innovative / Multi-Disciplinary Project	PW	0	0	0	2	2	1
Total				**16**	**0**	**6**	**4**	**26**	**21**

*- Electives Structure: 3 0 0 0 3 / 2 0 2 0 3; #-Offered only for NCC students

Semester VII

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Theory Courses									
1	U23CB103	Principles of Management	HS	3	0	0	0	3	3
2	U23XXXXX	Professional Elective III*	PE	3	0	0	0	3	3
3	U23XXXXX	Professional Elective IV*	PE	3	0	0	0	3	3
4	U23XXXXX	Open Elective II*	OE	3	0	0	0	3	3
5	U23CB104	Project Management and Finance	HS	1	0	0	0	1	1
Project Work									
6	U23AD653	Project Work - Phase I	PW	0	0	0	6	6	3
Total				**13**	**0**	**0**	**6**	**19**	**16**

*- Electives Structure: 3 0 0 0 3 / 2 0 2 0 3.

Semester VIII

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Project Work									
1	U23AD654	Project Work-Phase II	PW	0	0	0	16	16	8
Total				**0**	**0**	**0**	**16**	**16**	**8**

L→Lecture; T→Tutorial; P→Practical; J→Project; TC→Total Classes/wk; C→Credit.

CREDIT SUMMARY*

Sl. No.	Course Category	Credits per Semester								Credits	Credit %
		I	II	III	IV	V	VI	VII	VIII		
1	**HS**	3	3	-	-	-	-	4	-	10	6.17
2	**BS**	4	7	4	4	-	-	-	-	19	11.73
3	**ES**	13	4	4	-	4	-	-	-	25	15.43
4	**PC**	-	9	17	15	15	14	-	-	70	43.21
5	**PE**	-	-	-	-	3	3	6	-	12	7.41
6	**OE**	-	-	-	-	-	3	3	-	6	3.70
7	**PW**	-	-	-	1	-	1	3	8	13	8.02
8	**EM**	1	1	-	2	1	-	-	-	5	3.09
9	**MC**	-	-	-	NC	NC	-	-	-	-	-
10	**HSMC**	1	1	-	-	-	-	-	-	2	1.24
	OC	-	✓	-	✓	-	✓	-	-	-	-
Total		**22**	**25**	**25**	**22**	**23**	**21**	**16**	**8**	**162**	**100**

Total Number of Credits: 162

***Excluding NCC and Honours Courses**

7.3 Professional Elective Courses

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
Vertical 1— Data Science									
1	U23AD511	Knowledge Engineering	PE	3	0	0	0	3	3
2	U23AD512	Cognitive Science	PE	3	0	0	0	3	3
3	U23AD513	Data and AI Ethics	PE	3	0	0	0	3	3
4	U23AD514	Information Retrieval	PE	3	0	0	0	3	3
5	U23AD581	Health Care Analytics	PE	2	0	2	0	4	3
6	U23AD582	Soft Computing Techniques	PE	2	0	2	0	4	3
7	U23AD583	Social Media Analytics	PE	2	0	2	0	4	3
8	U23AD584	Business Intelligence	PE	2	0	2	0	4	3
Vertical 2— Machine Learning									
1	U23AM511	Statistical Analysis and Computing	PE	3	0	0	0	3	3
2	U23AM581	Time Series Analysis and Forecasting	PE	2	0	2	0	4	3
3	U23AM582	Video Analytics	PE	2	0	2	0	4	3
4	U23AM583	Text and Speech Analytics	PE	2	0	2	0	4	3
5	U23AM584	Data Warehousing and Mining	PE	2	0	2	0	4	3
6	U23AM585	Generative AI	PE	2	0	2	0	4	3
7	U23AM586	Multi – Prompt Engineering	PE	2	0	2	0	4	3
8	U23AM587	Robot Kinematics and Dynamics	PE	2	0	2	0	4	3
9	U23AM588	Robotic Process Automation	PE	2	0	2	0	4	3
Vertical 3— Cyber Security and Data Privacy									
1	U23CC521	Social Network Security	PE	3	0	0	0	3	3
2	U23CC522	Engineering Secure Software Systems	PE	3	0	0	0	3	3
3	U23CC523	Malware Analysis	PE	3	0	0	0	3	3
4	U23CC583	Digital and Mobile Forensics	PE	2	0	2	0	4	3
5	U23CC584	Modern Cryptography	PE	2	0	2	0	4	3
6	U23CC585	Cryptocurrency and Blockchain Technologies	PE	2	0	2	0	4	3
7	U23CC586	Network Security	PE	2	0	2	0	4	3
Vertical 4- Software Engineering									
1	U23CB531	Software Quality Management	PE	3	0	0	0	3	3
2	U23CB532	Free and Open Source Software	PE	3	0	0	0	3	3
3	U23CB535	Software Architecture	PE	3	0	0	0	3	3
4	U23CB589	Agile Software Development	PE	2	0	2	0	4	3
5	U23CB590	Advanced Software Testing	PE	2	0	2	0	4	3
6	U23CB591	Software Requirement Engineering	PE	2	0	2	0	4	3
7	U23CB592	Continuous Integration and	PE	2	0	2	0	4	3

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
		Continuous Deployment							
Vertical 5- Full Stack Development									
1	U23CS521	Web Application Security	PE	3	0	0	0	3	3
2	U23CS522	Cloud Services Management	PE	3	0	0	0	3	3
3	U23CS588	MVC Frameworks	PE	2	0	2	0	4	3
4	U23CS589	Flutter and Dart	PE	2	0	2	0	4	3
5	U23CS590	Docker and Kubernetes	PE	2	0	2	0	4	3
6	U23CS591	UI Design with Figma	PE	2	0	2	0	4	3
7	U23CS592	Groovy on Grails	PE	2	0	2	0	4	3
Vertical 6 - Cloud Computing									
1	U23IT521	Cloud Economics	PE	3	0	0	0	3	3
2	U23IT522	Cloud Networking and Connectivity	PE	3	0	0	0	3	3
3	U23IT523	Security on Cloud	PE	3	0	0	0	3	3
4	U23IT524	Compute Solutions and Serverless Services	PE	3	0	0	0	3	3
5	U23IT525	Cloud storage solutions	PE	3	0	0	0	3	3
6	U23IT526	Cloud Native development and Containers	PE	3	0	0	0	3	3
7	U23IT583	Cloud Virtualization	PE	2	0	2	0	4	3
8	U23IT584	Data Analytics on Cloud	PE	2	0	2	0	4	3

7.4 Open Elective Courses

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
1	U23OCC01	Network Protocols	OE	3	0	2	0	4	3
2	U23OCC02	High Speed Networks	OE	3	0	0	0	3	3
3	U23OCC03	Introduction to Industrial Networking	OE	3	0	0	0	3	3
4	U23OCC04	Basics of Mobile Communication	OE	3	0	0	0	3	3
5	U23OCC05	Introduction to Wireless Communication Networks	OE	3	0	0	0	3	3
6	U23OCB01	Algorithmic Trading Strategies	OE	2	0	2	0	4	3
7	U23OCB02	Business Simulation	OE	2	0	2	0	4	3
8	U23OCB03	Principles of Taxation	OE	3	0	0	0	3	3
9	U23OCB04	Strategic Business Leader	OE	2	0	2	0	4	3
10	U23OCB05	Information Systems Control and Audit	OE	3	0	0	0	3	3
11	U23OCS81	Object Oriented Programming using Java	OE	2	0	2	0	4	3
12	U23OCS82	Database Technologies	OE	2	0	2	0	4	3
13	U23OCS83	Full Stack Technologies	OE	2	0	2	0	4	3

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
14	U23OCS84	Agile Software Practices	OE	2	0	2	0	4	3
15	U23OCS85	Fundamentals of Python Programming	OE	2	0	2	0	4	3
16	U23OAM01	Deep Learning Models	OE	3	0	0	3	3	3
17	U23OAM02	Video and Speech Analytics	OE	3	0	0	3	3	3
18	U23OAM03	Industrial Machine Learning	OE	3	0	0	3	3	3
19	U23OAM04	Machine Learning for Smart Cities	OE	3	0	0	3	3	3
20	U23OSY01	Foundations of Ethical Hacking	OE	3	0	0	0	3	3
21	U23OSY02	Cyber Security Auditing and Assurance	OE	3	0	0	0	3	3
22	U23OSY03	Application Security	OE	3	0	0	0	3	3
23	U23OEC01	Principles of Analog and Digital Communication	OE	3	0	0	0	3	3
24	U23OEC02	Introduction to VLSI Design	OE	2	0	2	0	4	3
25	U23OEC03	Basics of Biomedical Instrumentation	OE	3	0	0	0	3	3
26	U23OEC04	Introduction to Image Processing	OE	2	0	2	0	4	3
27	U23OEC05	Embedded C and RTOS	OE	2	0	2	0	4	3
28	U23OEC06	Drone Technology	OE	3	0	0	0	3	3
29	U23OEE01	Solid State Electronics	OE	2	0	2	0	4	3
30	U23OEE02	Non-Conventional Energy Resources	OE	2	0	2	0	4	3
31	U23OEE03	Energy Conservation Practices	OE	3	0	0	0	3	3
32	U23OEE04	Energy Auditing and Management	OE	2	0	2	0	4	3
33	U23OEE05	Introduction to Hybrid and Electric Vehicles	OE	3	0	0	0	3	3
34	U23OEE06	Design of Solar Photovoltaic Systems	OE	3	0	0	0	3	3
35	U23OEE07	PLC and SCADA	OE	2	0	2	0	4	3
36	U23OIT01	Introduction to Blockchain Technology	OE	3	0	0	0	3	3
37	U23OIT02	Fundamentals of IT Infrastructure Management	OE	3	0	0	0	3	3
38	U23OIT03	Basics of Cloud Technology	OE	2	0	2	0	4	3
39	U23OIT04	Introduction to Computer Networks	OE	2	0	2	0	4	3
40	U23OIT05	Game Programming Fundamentals	OE	2	0	2	0	4	3
41	U23OME01	Quality Management	OE	3	0	0	0	3	3
42	U23OME02	Industrial Safety Engineering	OE	3	0	0	0	3	3
43	U23OME03	Industry 4.0	OE	3	0	0	0	3	3
44	U23OME04	Machine Vision	OE	3	0	0	0	3	3
45	U23OME05	Product Distribution and Promotion Management	OE	3	0	0	0	3	3
46	U23OME06	Business Ethics, Corporate Social Responsibilities and Governance	OE	3	0	0	0	3	3
47	U23OME81	Product Design and Development	OE	2	0	2	0	4	3
48	U23OME82	Additive Manufacturing and Tooling	OE	2	0	2	0	4	3
49	U23OME83	Product Lifecycle Management	OE	2	0	2	0	4	3

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Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
50	U23OME84	Robotics and Expert Systems	OE	2	0	2	0	4	3

7.5 Industry Oriented Courses

Sl. No.	Course Code	Course Name	Category	Periods/wk				TC	C
				L	T	P	J		
1	U23IAD51	Angular JS	EM	0	0	2	0	2	1
2	U23IAD52	Node.js and GraphQL	EM	0	0	2	0	2	1
3	U23IAD53	Kotlin for Android Development	EM	0	0	2	0	2	1

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SEMESTER I

U23MA201	Calculus for Engineers	L	T	P	J	C
		3	1	0	0	4

1. Course Description:

This course is designed to provide solid foundations in differential and integral calculus, emphasizing practical applications in science and engineering discipline. Differential equations are essential for understanding dynamic systems, physical phenomena, mathematical modeling, and simulating real-world problems. Vector calculus explores the mathematical framework necessary for understanding and analyzing vector fields in three-dimensional space.

2. Course Objectives:

1. Familiarize the students with functions of several variables.
2. Acquaint them with methods of evaluating multiple integrals.
3. Facilitate them with techniques in solving ordinary differential equations.
4. Impart an idea of vector calculus and its physical interpretation.
5. Elucidate various techniques of vector integration.

3. Syllabus: **45 + 15= 60 Periods**

Unit-I: Differential Calculus **(9+3)**

Limits and Continuity; Partial derivatives: Total derivative, differentiation of implicit functions; Jacobian, properties; Taylor's series; Maxima and minima of functions of two variables.

Unit-II: Integral Calculus **(9+3)**

Double integrals: Integrals in cartesian and polar coordinates ; Area enclosed by plane curves ; Change of order of integration ; Change of variables between cartesian and polar co-ordinates.

Unit-III: Ordinary Differential Equations **(9+3)**

Higher order linear differential equations with constant coefficients; Method of variation of parameters; Cauchy's and Legendre's linear differential equations; Application of ordinary differential equations in spring mass system.

Unit-IV: Vector Differentiation **(9+3)**

Vector and scalar functions; Derivatives: Curves, tangents, arc length, curves in mechanics, velocity and acceleration; Gradient of a scalar field; Directional derivative; Divergence of a vector field ; Curl of a vector field ; Scalar potential function.

Unit-V: Vector Integration **(9+3)**

Line Integral; Green's theorem in a plane ; Triple integral; Gauss divergence theorem; Stoke's theorem (statement only).

List of Tutorials:

1. The working procedure, Basic commands and symbolic computation. (CO 1)
2. Drawing the curve for the given function f(x) and the surface for the given function. (CO 1)
3. To find the Partial derivative of a given function f (x, y). (CO 1)
4. Evaluating Extreme values of a single variable function. (CO 1)
5. Evaluating the Maxima and minima of functions of two variables. (CO 1)

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6. Differentiation of various functions. (CO 1)
7. Integration - Definite and indefinite integrals - Constant and variable limits. (CO 2)
8. Understanding integration as an Area under the curve. (CO 2)
9. Evaluating triple integrals. (CO 2)
10. Visualizing different surfaces. (CO 2)
11. Evaluating gradient, curl and divergence. (CO 4)
12. Directional derivative of a given function. (CO 4)
13. Evaluating line integrals. (CO 5)

Text Books:

1. Erwin Kreyszig, "Advanced Modern Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Ltd, Singapore, 2017.
2. Dennis G Zill, "Advanced Engineering Mathematics", 6th Edition, Jones & Bartlett India P Ltd., New Delhi, 2017.
3. Grewal. B. S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, New Delhi, 2015.
4. Maurice D. Weir, Joel Hass, Christopher Heil "Thomas' Calculus",14th Edition, Pearson Education, New Delhi, 2018.

References:

Reference Books:

1. John Bird, "Higher Engineering Mathematics", An imprint of Elsevier, Burlington, Reprint 2010.
2. Bali. N. P and Manish Goyal," A Text book of Engineering Mathematics", 8th Edition, Laxmi publications Ltd, 2011.
3. Srimanta Pal and Subodh C Bhunia, "Engineering Mathematics", 3rd Edition, Oxford University Press, New Delhi, 2016.

Web Resources:

1. https://www.youtube.com/watch?v=riXcZT2ICjA
2. https://www.youtube.com/watch?v=1CBOwkS7nII
3. https://www.youtube.com/watch?v=rfG8ce4nNh0
4. https://www.youtube.com/playlist?list=PL5Dqs90qDljXm4Q6htsu9C88_gSebN33z

MOOC/NPTEL/SWAYAM Courses:

1. https://archive.nptel.ac.in/courses/111/104/111104092/
2. https://archive.nptel.ac.in/courses/111/105/111105122/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23MA201.1	Classify the extreme values of functions of two variables.
U23MA201.2	Apply integration concepts to compute area of the given surfaces, integrals in cartesian and polar coordinates.
U23MA201.3	Assess various techniques in solving differential equations.
U23MA201.4	Compare the ideas of vector differentiation and exhibit the relation between them.
U23MA201.5	Apply Green's theorem, Stoke's theorem and Divergence theorem to evaluate integrals.

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U23CS301	Problem Solving using C	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

This course introduces students to the fundamental concepts of programming using the C language. The course covers essential topics such as basic C programming constructs, conditional and looping statements, modular programming, and advanced concepts like pointers, arrays, and structures. Through theoretical lectures, practical demonstrations, and coding exercises, students will develop problem-solving skills and learn how to design and implement efficient algorithms to solve a variety of complex problems.

2. Course Objectives:

1. Equip students with the skills to write robust, readable, and maintainable code for diverse applications.
2. Instruct students on utilizing control structures and functions to manage program flow, make informed decisions, and automate repetitive tasks.
3. Enhance students' abilities in optimizing memory usage and promoting code reusability.
4. Guide students in efficiently organizing and processing data, enabling them to write clean, well-structured code that addresses real-world challenges.
5. Train students in effectively working with strings, user-defined data types, and file operations.

3. Syllabus: **45 periods**

Unit-I: C Fundamentals **(9)**

Basic computer organization, Problem-solving techniques, Algorithm, Flowchart, Pseudocode; Introduction to C programming: Phases of a C program, Features of C, Keywords, Variable Name, Scope, Declaration, Coding Standards, Data Types and sizes: integer, float and character types, constants, Formatted I/O, Operators, Bitwise Manipulations, Expression Evaluation, Type Conversions, Preprocessor Directives

Unit-II: Control Structures **(9)**

Conditional and Branching Statements: if, if-else, else-if ladder, nested-if, switch constructs, range using switch, Looping constructs: for, while, do-while -break and continue- goto and Label

Unit-III: Pointers and Functions **(9)**

Pointer - Types of Pointers: NULL, Dangling, Generic Pointers, Wild pointer, Arithmetic Operations in Pointer, Pointer to pointer, Functions: The anatomy of a function, Types of functions, Pointers and Function Arguments: Call by Value and Call by Reference, Function Pointers, return statement, Recursion, Storage Classes

Unit-IV: Arrays **(9)**

Arrays: Declaring and initializing 1D arrays, Two-dimensional arrays, Multi-dimensional arrays, Variable Length Arrays, Dynamic Memory Allocation, Passing 1D and 2D Array as arguments, Pointers and Arrays, Array of pointers

Unit-V: Strings, User-Defined Data Types and Files **(9)**

Strings: Introduction – string handling functions, Two-dimensional array of strings, Structure: Basics of structure- Nested structures–Array of structures – Pointer to structures – Unions - Bit Fields-Files: Basics– File Functions - Random Access Files

Text Books:

1. Herbert Schildt, "C – The Complete Reference", Tata McGraw Hill Publishing Company, New Delhi, 2017.
2. Kernighan B. W. and Ritchie D. M., "C Programming Language (ANSI C)", Prentice Hall of India Private Limited, New Delhi, 2010.

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References:

Reference Books:

1. Deitel and Deitel, "C How to Program", Pearson Education, New Delhi, 2011.
2. Simple Program Design: A Step-by-Step Approach, Fifth Edition by Lesley Anne Robertson

Video References:

1. https://www.youtube.com/watch?v=EjavYOFoJJ0&list=PLdo5W4Nhv31a8UcMN9-5ghv8qyFWD9_S
2. https://www.youtube.com/watch?v=irqbmMNs2Bo

MOOC/NPTEL /SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
2. https://onlinecourses.nptel.ac.in/noc23_cs53/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS301.1	Understand problem-solving techniques and typical programming constructs
U23CS301.2	Apply looping and conditional constructs to solve real-world problems
U23CS301.3	Apply arrays and functions effectively to address complex programming challenges
U23CS301.4	Understand and apply best practices in pointers, memory allocation and error handling for modular programming efficiency
U23CS301.5	Choose and implement complex data structures using structures and Unions, applying advanced file operations in C for effective problem-solving

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U23HS181	Technical English	L	T	P	J	C
		2	0	2	0	3

1. Course Description:

This course aims to educate the first year BE/B.Tech. students in the context of technical communication and facilitate them to use vocabulary in different academic and professional scenarios. It also cultivates their LSRW skills, namely Listening, Speaking, Reading and Writing skills thereby, improving their proficiency in oral and written communication. It also covers all the areas of Grammar, Word formation, Summarizing, Report writing which are necessary for the students of Engineering and Technology.

2. Course Objectives:

1. Help students learn different reading techniques like skimming and scanning, so they can better understand and analyse various texts.
2. Improve students' skills in writing clear and organized sentences and paragraphs, and teach them how to write informal letters for different purposes.
3. Strengthen students' understanding of basic grammar rules, such as parts of speech, articles, and tenses, to make their writing and speaking more accurate.
4. Train students to listen carefully to audio materials and participate in speaking activities like introductions and role-plays to improve their communication skills.
5. Encourage students to use their language skills in everyday situations, like writing informal letters and doing role-plays, to build confidence and fluency in English.

3. Syllabus: **30+30=60 Periods**

Unit-I: Fundamentals of Language Skills **(6)**

Types of Reading: Intensive and Extensive - Skimming and Scanning Techniques - Reading Comprehension Strategies; Word Formation Techniques - Sequence Words in Writing) - Hints Development for Writing - Informal Letters: Congratulating, Apologizing, etc.; Grammar: Parts of Speech - Articles (Definite and Indefinite) – Tense; Listening Types - Listening to Audio files and answering; Speaking - Introducing oneself & family - Role Play

Unit-II: Advanced Reading and Writing Strategies **(6)**

Reading articles from Newspapers & Magazines - Cloze Exercises; Writing Instructions and Recommendations - Paragraph Writing Techniques; Grammar: Homonyms, Homophones, and Homographs - Subject – Verb Agreement - Modal Verbs - Question Types: Wh-type, Yes/No, and Tag Questions; Listening for Specific Information: Announcements and Radio Broadcasts

Speaking: Extempore - Just A Minute (JAM) Sessions

Unit-III: Advanced Communication Skills **(6)**

Reading for Specific Information & Identifying Lexical and Contextual Meaning; Writing Formal Letters: Seeking Permission for Industrial Visit - Letter of Invitation (Acceptance/Declination) - Arranging Jumbled Sentences; Grammar: Cause and Effect Expressions - Purpose and Function - Phrases - Compound Nouns; Listening to TED Talks & News Reading from English News Channels (CNN, NDTV, India Today, etc.) Speaking: Group Discussion

Unit-IV: Effective Written Communication **(6)**

Summarizing Techniques: Paraphrasing Skills - Note Making Strategies; Preparing Job Application - Email Etiquette and Writing Emails - Free Writing on Any Given Topic; Grammar: Phrasal Verbs - Types of Sentences (Simple, Compound, Complex) - Single Sentence Definitions; Listening and summarizing; Speaking: Narrating a Story

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Unit-V: Technical Presentation Skills **(6)**

Reading practice based on Competitive Examinations; Writing: Preparing Transcripts for Speeches - Pictorial Representations: Flowcharts, Pie Charts, Bar Charts, Tabular Columns; Grammar: Single Word Substitutes - Spotting Errors; Listening to Eminent Personality Interviews & Other Forms of Interviews; Speaking - Compering, Welcome Address & Vote of Thanks

List of Exercises: **30 periods**

1. Listening to Audio files and answering the questions. (CO 1)
2. Listening for specific information like announcements and Radio Broadcasts (CO 1)
3. Practice developing hints into full sentences or paragraphs. (CO 1)
4. Practice delivering short, impromptu speeches on various topics. (CO 2)
5. Listening to TED Talks & News Reading from English News Channels (CNN, NDTV, India Today etc.) (CO 1)
6. Listening to interviews of eminent personalities and analysing the content. (CO 4)
7. Practicing self-introduction in role play scenarios. (CO 3)
8. Participating in group discussions on various topics with emphasis on communication strategies and effective participation. (CO 3)
9. Exercises on narrating stories, focusing on structure and engagement. (CO 4)
10. Compering events, delivering Welcome Addresses, and practicing Vote of Thanks. (CO 5)

Text Books:

1. Jack C. Richards, “Interchange Student’s Book 1”, Cambridge University Press; Fourth Edition, 2015.
2. S. N. Mahalakshmi, “Technical English for Engineers”, V. K. Publications; Chennai, Eighth Edition, 2020.

References:

Reference Books:

1. Rizvi M.Ashraf, “Effective Technical Communication”, Tata McGraw Hill Publishing Company; New Delhi, 2015.
2. Andrea J.Rutherfoord, “Pearson Education” Inc. and The Darling Kindersley Publishing Inc., 2020.
3. Raman, Meenakshi and Sharma, Sangeetha “Technical Communication Principles and Practice”, 4. Oxford University Press; New Delhi, 2019.
4. Richards C. Jack, “Interchange”, Fourth edition; Cambridge University Press, 2020.
5. Butterfield, Jeff, “Soft skills for Everyone”, Sixth Indian Reprint, 2018.

Video References:

1. https://www.youtube.com/watch?v=tBtc6rpcMz4
2. https://www.youtube.com/watch?v=Ll23cChDSKE
3. https://www.youtube.com/watch?v=fyAtyAdCStM

Web Resources:

1. https://leo.stcloudstate.edu/grammar/subverag.html
2. http://www.learningdifferences.com/Main%20Page/Topics/Compound%20Word%20Lists/Compound_Word_%20Lists_complete.htm
3. http://examples.yourdictionary.com/examples-of-active-and-passive-voice.html
4. http://www.perfectyourenglish.com/grammar/numeral-adjectives.htm

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5. https://en.wikipedia.org/wiki/Commonly_misspelled_English_words
6. https://www.englisch-hilfen.de/en/grammar/if.htm
7. http://www.englishforeveryone.org/Topics/Reading-Comprehension.htm

MOOC/ SWAYAM /NPTEL Courses:

1. https://www.udemy.com/topic/communication-skills/free/
2. https://www.bbc.co.uk/learningenglish/english/course/how-to-speak-english

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23HS181.1	Apply basic reading techniques, construct clear sentences for informal correspondence, and enhance grammar and listening skills for effective communication.
U23HS181.2	Analyse complex texts, formulate precise instructions and recommendations, and utilize advanced grammar in spoken communication.
U23HS181.3	Simplify specific and contextual information, compose formal letters, and actively engage in group discussions.
U23HS181.4	Interpret and take notes proficiently, compose professional documents and emails, and demonstrate strong listening skills.
U23HS181.5	Analyse and create detailed technical documents and visual aids and deliver formal presentations and conduct interviews with confidence.

U23CS381	Application Design and Development	L	T	P	J	C
		2	0	2	0	3

1. Course Description:

Application Design and Development is a comprehensive integrated course that blends theoretical understanding with practical hands-on experience in creating diverse applications. Students will delve into essential web development concepts using HTML, CSS, and JavaScript, mastering the foundations of building interactive and responsive web interfaces. Additionally, they will learn version control using Git and GitHub, enabling collaborative development and effective management of project iterations.

Furthermore, students will explore mobile application development using MIT App Inventor, gaming application development with Construct 2, and image/video editing using Blender tools. Through a combination of theoretical lectures, interactive labs, and project-based learning, students will gain the skills necessary to design, develop, and deploy various types of applications.

2. Course Objectives:

1. To design and build visually appealing and interactive web pages using HTML and CSS, creating a strong foundation for web development
2. To make students create dynamic and interactive web pages using JavaScript, enhancing user experience and adding functionality to web applications
3. To create and manage Git repositories and how to collaborate using GitHub, including forking, cloning, and pull requests
4. To develop mobile applications for Android devices using MIT App Inventor's visual blocks programming
5. To create 2D games using Construct 2 and edit multimedia content using Blender

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3. Syllabus:	**(30+30 = 60 Periods)**
Unit-I: HTML and CSS	**(6)**
Software Development: SDLC (Waterfall Model)- Phases - Methods and Practices-Introduction to web- Standards and Terminologies.HTML: Introduction and versions-HTML 5-standards and tags-Head and Body-List-Labels-Tables-Forms-Videos and Audios-Figure, Figure Captions, Images CSS: Introduction-Embedded Types-CSS Selectors-Borders, Margins, Paddings-Colors and Backgrounds- Introduction to Bootstrap-Tailwind CSS	
Unit-II: Interactive Web Design using JavaScript	**(6)**
Introduction-Java Script adding Techniques-Variables and Operators- Conditional and Control Statements- Data Types and Functions-Events-Form Validation-Page Redirect-Java Script Exception Handling-Document Object Model (DOM)	
Unit-III: Git, Git Hub and Shell Scripting	**(6)**
Introduction to Git and GitHub-Terminologies-Local Repository Actions- Remote Repository Actions- Advanced Repository Actions-Branching-Merging-Software Developers Communities: Google Developers Group, Google Student Developers Community, Linux Developer Community, Stack Overflow, Kaggle Shell Scripting: Processing (PS) and Listing (LS)- File Creations and Handling-Users and Groups	
Unit-IV: Mobile Application Development with MITAI	**(6)**
Types of Mobile OS (Android and IOS)-Architecture- Phases of Mobile Application Development -MIT app inventor-Components-Viewer-Properties – Publishing an app	
Unit-V: Template-Driven Applications and Multimedia	**(6)**
Content Management System: Dynamic content flow - Collection fields – Search Engine Optimization, Multimedia: Design with Canva and Blender- Image and Video Editing – Game Development with Construct 2	
List of Experiments:	**(30)**

1. Develop a visually appealing static website with an intuitive user interface with multimedia content such as text, images and videos using HTML, CSS and JavaScript (CO1)
2. Create a simple form to collect the name, address, email ID and phone number from the user and use JavaScript to validate each field before submitting the form (CO1)
3. Create an interactive quiz that allows the user to select answers to multiple-choice questions. Use JavaScript to calculate the user's score and provide feedback based on their performance (CO1)
4. Create a simple animation using CSS and JavaScript. Use CSS to define the animation's properties, such as duration and timing and use JavaScript to trigger the animation in response to user input or other events (CO2)
5. Create a local repository using Git and perform basic operations such as initializing the repository, adding files, committing changes, and creating and managing multiple branches to organize and track changes (CO3)
6. Create a shell script that can automate file management tasks such as processing, listing, creation and handling of files and user and group management tasks (CO3)
7. Develop mobile applications using MITAI (Simple calculator, Step counter, a Weather app that retrieves current weather information from an API, Talk to Me, Translation App) (C04)
   a) Design a poster for an event using Canva templates (CO4)
   b) Create a visual infographic using Canva tools to present data and information (CO4)
8. Develop a simple 2D game using a Construct visual interface and event system (CO4)

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9. Model a 3D object using Blender modelling tools and techniques. Animate a short scene or character using Blender animation tools and a timeline (CO5)

Text Books:

1. Internet & World Wide Web How to Program, 5th edition, by Paul Deitel Harvey Deitel, Abbey Deitel, Pearson Publication, 2018.
2. App Inventor 2: Create Your Own Android Apps 2nd Edition by David Wolber, Hal Abelson, Ellen Spertus, Liz Looney, 2014.

Reference Books:

1. CS50's Web Programming with Python and JavaScript - https://cs50.harvard.edu/web/2020
2. Get Coding! Learn HTML, CSS & JavaScript & Build a Website, App & Game – by Young Rewired State, Walker Books, 2016.
3. Version Control with Git, by Jon Loeliger, Matthew McCullough, 2nd Edition, 2012.

Web References:

1. https://www.w3schools.com/html/html_css.asp
2. https://www.javatpoint.com/javascript-tutorial
3. https://www.freecodecamp.org/news/introduction-to-git-and-github/
4. https://appinventor.mit.edu/explore/ai2/tutorials
5. https://www.construct.net/en/tutorials/beginners-guide-construct-47
6. https://www.blender.org/support/tutorials/

MOOC/NPTEL /SWAYAM Courses:

1. https://in.coursera.org/learn/html-css-javascript-for-web-developers
2. https://amigoscode.com/p/git-github
3. Ultimate-web-design-course-https://university.webflow.com/courses/ultimate-web-design- course

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS381.1	Utilize HTML5 and CSS to develop responsive web
U23CS381.2	Create Interactive web applications using JavaScript
U23CS381.3	Analyze and apply GIT and GIT HUB operations and advanced repository actions
U23CS381.4	Create mobile applications using the MIT app inventor
U23CS381.5	Create simple game applications using Construct

U23EC381	Electronics and Microprocessor	L	T	P	J	C
		3	0	2	0	4

1. Course Description:

This course offers an in-depth exploration of the fundamental concepts in semiconductor theory, diodes, and transistors. It features a detailed study of the 8085 microprocessor, where students will learn to write and implement assembly programs. Additionally, the course covers the 8051 microcontroller, focusing on its architecture, instruction set, and the principles of interfacing with peripheral devices. By the end of this course, students will have a comprehensive understanding of both microprocessors and microcontrollers, equipping them with the skills needed to excel in the field of electronics.

2. Course Objectives:

1. To facilitate understanding of semiconductor theory and diode operation.

2. To teach BJT and FET operation and biasing techniques.
3. To instruct on 8085 microprocessor architecture and assembly programming.
4. To teach 8051 microcontroller architecture and instruction set.
5. To explain interfacing principles and peripheral devices of the 8051.

3.Syllabus: **45 + 30 = 75 Periods**

Unit-I: Diode and its Applications **(9)**

Intrinsic and extrinsic semiconductor; P type and N type semiconductor; PN junction diode: properties, biasing and VI characteristics; half wave rectifier and centre tap full wave rectifier; Zener diode; Zener diode as voltage stabilizer.

Unit-II: Transistors and Amplifiers **(9)**

Transistor: Transistor action, Transistor as an amplifier, CB, CE, CC connections and its comparison, transistor biasing; Field effect transistor: types, JFET, working principle, difference JFET and BJT; MOSFET: types, circuit operation of D-MOSFET and E-MOSFET.

Unit-III: Introduction to 8085 Microprocessor **(9)**

8085 Hardware Architecture; 8085 Pin out; register organization; addressing modes; instruction set; programming 8085 (commonly used instructions only).

Unit-IV: Introduction to 8051 Microcontroller **(9)**

8051 architecture; memory organization; special function registers; port operation; timer/counters; serial interface; interrupts; operand addressing; instruction set.

Unit-V: Interfacing 8051 Microcontroller **(9)**

LCD & Keyboard Interfacing; ADC, DAC & Sensor Interfacing; External Memory Interface; Stepper Motor and Waveform generation.

List of Experiments: **(30 Periods)**

1. Develop the circuit of the P-N junction diode and plot the V-I characteristics to determine the knee voltage by varying the forward bias voltage and current in reverse biased condition due to minority carriers. (CO 1)
2. Analyze the breakdown mechanism of Zener diode for voltage regulation in a circuit with varying load currents and plot its VI characteristics. (CO 1)
3. Construct the circuit of BJT in Common Emitter Configuration and plot its input and output characteristic curves by varying the V_{BE} and V_{CE} and plotting the I_B and I_C. (CO 2)
4. Write assembly language programs using 8085 instructions for performing various arithmetic and logical operations and verify the same for various test cases. (CO 3)
5. Write assembly language programs using 8051 instructions for performing various arithmetic and logical operations and verify the same for various test cases. (CO 4)
6. Design of simple automation projects using 8051 Microcontroller. (CO 5)

Text Books:

1. V.K.Mehta and Rohit Mehta, “Principles of Electronics” S.Chand, 12edition, 2014 (Unit I & II)
2. Krishna Kant, “Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096”, PHI, 2013 (Unit III, IV & V)

References:

Reference Books:

1. Robert Boylestad, Louis Nashelsky, “Electronic devices and Circuit theory”, Pearson, 11/e, 2015

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2. A.K.Ray and K.M.Bhurchandi, "Advanced Microprocessor and Peripherals", MGH, 3/e, 2017
3. Mohammed Ali Mazidi, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson, 2edition, 2012

Journals:

1. IEEE Transactions on Electronics Devices
2. Microelectronics Journal

Magazines:

1. https://www.electronicdesign.com/
2. https://spectrum.ieee.org/

Web Resources:

1. https://www.allaboutcircuits.com/
2. https://www.electronics-tutorials.ws/

MOOC / NPTEL / SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc22_ee12/preview
2. https://archive.nptel.ac.in/courses/117/103/117103063/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23EC381.1	Differentiate between signal diodes, rectifiers, and Zener diodes based on their characteristics and applications.
U23EC381.2	Analyze BJT and FET symbol representations, internal structures, and biasing circuits.
U23EC381.3	Comprehend the architecture, instruction set and write assembly program for 8085 Microprocessor
U23EC381.4	Comprehend the architecture, instruction set and write assembly program for 8051Microcontroller
U23EC381.5	Interpret the working of peripherals and interface with 8051.

U23CS351	Problem Solving using C Laboratory	L	T	P	J	C
		0	0	4	0	2

1. Course Description:

The Problem Solving Using C Laboratory is a practical course designed to complement theoretical knowledge with hands-on experience in programming using the C language. Through a series of laboratory sessions, students will delve into the basic concepts of C programming, including conditional and looping statements, modular programming, and advanced topics such as pointers, arrays, and structures. By actively engaging in coding exercises and projects, students will develop problem-solving skills, algorithmic thinking, and proficiency in implementing efficient solutions to various computational problems.

2. Course Objectives:

1. Instruct students on developing robust, readable, and maintainable code for a variety of applications.
2. Teach students to effectively use control structures and functions to manage program flow, make decisions, and automate repetitive tasks.

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3. Enhance students' ability to optimize memory usage and promote code reusability in their programs.
4. Guide students in organizing and processing data efficiently, enabling them to write clean, structured code that addresses real-world problems.
5. Train students in working proficiently with strings, user-defined data types, and file operations.

3. List of Experiments: 60 Periods

1. Develop flow charts and solve simple real-life or scientific or technical problems (Traffic signal control / Water level controller / Temperature control system / Automatic washing machine control system / Automatic Street light control system / Electricity Billing / Retail shop billing /Computing Electrical Current in Three Phase AC circuits) (Minimum 3 problems) (CO1)
2. Implementation of applications of input and output statements. (Integer, char, Float, string input and output, ASCII value of character, User details) (CO1)
3. Implementation operators and expressions (Centigrade to Fahrenheit, Quotient and Remainder, Kilometres per hour to miles per hour, Hour and Minutes, Profit Calculator) (CO1)
4. Implementation of real-time applications using conditional statements. (Vowel or Consonant, Eligible for casting vote, Leap year or not, Display the description for the given grade, Display number of days in a month, Calculator, Triangle type, Roots of a quadratic equation) (CO1)
5. Implementation of technical applications using iterative loops (Display first N natural numbers, Read N numbers and find their sum and average, find cube of the number up to a given integer, Multiplication table, Sum of N natural numbers, Sum of N natural odd numbers, Pattern printing) (CO2)
6. Implementation of the one-dimensional array (Display the array elements, Elements in reverse order, Sum of array elements, make a copy of array elements, Maximum and minimum, odd sum and even sum) (CO2)
7. Implementation of a two-dimensional and multi-dimensional array (sum, subtraction, transpose, multiplication, frequency of even numbers, print diagonals, sum of diagonal elements, compare) (CO2)
8. Implementation of Functions in the program (Factorial, largest number, area of shape, sum of digits, prime number or not) (CO2)
9. Implementation of real-time applications using recursion (factorial, Fibonacci series, count digits of a number, length of string, prime or not, GCD, sum of all digits, palindrome) (CO2)
10. Implementation of a pointer in applications (swap two numbers, print string, read array elements, double pointer, find the maximum number, palindrome, reverse array, dynamic memory allocation) (CO3)
11. Implementation of strings handling functions with and without library functions (compare two strings, reverse, concatenate, copy, palindrome, count number of characters, number of words, find, replace) (CO4)
12. Implementation of file-handling operations (read, write, append file, compare two files, read student details and store into files) (CO4)
13. Implementations of Structure in real-time applications (Accept & display employee details, Calculate total payment of workers, Library operations, Menu-driven program for employee structure) (CO5)

14. Implementations of Union in programs (Accept & display employee details, Calculate total payment of workers, Library operations, Menu-driven program for employee structure) (CO5)
15. Mini Project: Develop an application for any real-world problem

Reference Books:

1. Herbert Schildt, "C – The Complete Reference", Tata McGraw Hill Publishing Company, New Delhi, 2017.
2. Kernighan B. W. and Ritchie D. M., "C Programming Language (ANSI C)", Prentice Hall of India Private Limited, New Delhi, 2010.
3. Deitel and Deitel, "C How to Program", Pearson Education, New Delhi, 2011.
4. Simple Program Design: A Step-by-Step Approach, Fifth Edition by Lesley Anne Robertson

Video References:

1. https://www.youtube.com/watch?v=EjavYOFoJJ0&list=Pldo5W4Nhv31a8UcMN9-35ghv8qyFWD9_S
2. https://www.youtube.com/watch?v=irqbmMNs2Bo

MOOC/NPTEL /SWAYAM Courses:

1. https://www.udemy.com/course/c-programming-2019-master-the-basics
2. https://www.tutorialspoint.com/cprogramming

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS351.1	Design solutions for real-world problems with programming constructs
U23CS351.2	Solve complex programming problems with arrays and functions
U23CS351.3	Implement dynamic memory addressing techniques with Pointers
U23CS351.4	Implement various error-handling techniques for file operations
U23CS351.5	Implement complex data structures such as structures and unions in C to manage and organize data effectively

U23GE351	Engineering Practices Laboratory	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

The course encompasses a comprehensive set of practical units aimed at providing hands-on experience in Computer Science, Mechanical, Electrical and Electronics Engineering fields.

Computer Science and Engineering Practices:

The students will be engaged in Computer assembly and disassembly, honing troubleshooting skills for both hardware and software issues.

Mechanical Engineering Practices:

The students will be delving into Mechanical Engineering practices which include plumbing, basic machining operations and rapid prototyping with 3D printing. The exploration extends to the assembly of a centrifugal pump, hands-on exercises involving pump/motor, submersible pump sets and refrigeration & air-conditioning systems.

Electrical Engineering Practices:

The students will be focusing on Electrical Engineering practices which involve UPS connections, domestic wiring, safety precautions and the design of solar PV systems.

Electronics Engineering Practices:

The students will be focusing on Electronics Engineering practices which include soldering techniques, a study of smartphone components and practical projects in home automation.

Through this multifaceted course, students gain a well-rounded understanding of essential skills in Computer Science, Mechanical, Electrical & Electronics preparing them for diverse applications in those fields.

2. Course Objectives:

1. To impart knowledge on computer assembling, disassembling and troubleshooting.
2. To provide exposure to the students with rapid prototyping with 3D printing and plumbing operations.
3. To gain practical experience in UPS connections, domestic house wiring and solar PV systems.
4. To expose the students to understanding home automation, smartphone operation and soldering and desoldering techniques.

3. Syllabus: **30 Periods**

Unit-I: Computer Science and Engineering Practices **(7)**

1. Troubleshooting Desktops and PCs
2. Disassembly and Assembly of Desktops and PCs
3. Setting up Basic Computer Networks
4. Demonstration of AR/VR Technologies and Their Applications in Engineering Design, Simulation, and Training

Unit-II: Mechanical Engineering Practices **(8)**

1. Hands-on exercise on plumbing connection of a residential building involving minor troubleshooting
2. 3D Printing of simple engineering objects without a support structure
3. 3D Printing of simple engineering objects with support structure
4. Hands-on exercise on basic connections and maintenance with minor troubleshooting of Refrigeration System (Study)

Unit-III: Electrical Engineering Practices **(7)**

1. UPS Connection – Hands-on exercise on basic electrical connections with UPS Connection

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2. Domestic Wiring – Hands-on exercise on basic domestic wiring 3. Safety Precautions – Hands-on exercise on electrical earthing and safety precautions 4. Renewable Energy – Design of Solar PV System for Residence (Study)
Unit-IV: Electronics Engineering Practices **(8)**
1. Manual soldering of electronic components onto PCB 2. Analyse Smartphone component integration, design choices and their effects on performance. 3. Design and Building of Simple Home Automation System

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23GE351.1	Perform the basic troubleshooting of the PC including assembly and disassembly.
U23GE351.2	Carry out minor plumbing troubleshooting in a residential building & print 3D components with or without support materials.
U23GE351.3	Carry out minor troubleshooting and maintenance tasks in a Refrigeration System.
U23GE351.4	Perform basic domestic wiring of a residential building with provision of inverter and safety measures and Design solar PV System for residence.
U23GE351.5	Execute basic home automation projects.

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U23EM751	Soft Skills	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

This course on Soft Skills is designed to enhance the professional development of engineering students by refining essential interpersonal and communication skills. It focuses on cultivating critical attributes such as effective communication, active listening, teamwork, leadership, and time management. The course also emphasizes the importance of professional etiquette, advanced communication techniques, technical writing, and the ability to navigate formal and informal contexts. By integrating these elements, students will develop the competencies necessary for successful collaboration, decision-making, and professional growth in the engineering field.

2. Course Objectives:

1. Develop foundational language skills by reinforcing key communication principles.
2. Instill positive behavioural traits to prepare students for future interactions in the corporate environment.
3. Equip students with the knowledge and skills needed to communicate ideas on social issues, promoting a sense of responsibility and active citizenship.
4. Enhance leadership abilities, teamwork strategies, and the capacity to foster effective connections through impactful communication.
5. Strengthen confidence and public speaking skills by offering experiential learning and techniques to overcome presentation anxiety and communicate effectively in front of an audience.

3. Syllabus: **30 Periods**

Unit-I: Personality and Professional Development Skills **(6)**

Interpersonal skills: communication skills, active listening, teamwork, empathy, leadership, motivation, social skills – effective body language – workplace etiquette – types of speeches: memorized speech, manuscript speech, impromptu, and extempore.

Unit-II: Advanced Communication Skills **(6)**

Word and sentence stress – clear individual sounds – intonation patterns – pronunciation – mother tongue intrusion – tongue twisters – conversation practice: discourse markers, slang, colloquial expressions, collocation – making mini presentations – extending on conservations – collaborative task.

Unit-III: Effective Communication Skills **(6)**

Verbal and non-verbal communication – formal and informal English – grammatical features: impersonal passives, nominal compounds, third persons, empty verbs, present tense, imperatives, active voice, jargon, cliches – presentation skills – resume preparation – group discussions – mock interviews.

Unit-IV: Team Skills And Interpersonal Communication **(6)**

Personal skills: time management, motivating others, assessing alternatives and making decisions, accurate written work, organisational skills, attention to detail, negotiation and mediation skills – public speaking – panel discussion – debates

Unit-V: Engineering Journalism **(6)**

Technical writing style: accuracy, conciseness, clarity, objectivity – abstract writing – technical documents writing – blogs – editing – copyrights – plagiarism

References:

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Reference Books:

1. Norman Lewis, “Word power made easy”.2020.
2. Sylvia Reyes,” Team Building: The Ultimate Guide to Build & Manage Winning Teams”, MC Graw Hill, 2014.
3. Dan Clay, how to write the perfect resume 2018.
4. Tyler Hayden,” Communication Activities: A Team Building Activity Book”, 2019.
5. Ian Tuhovsky, “Communication Skills Training: A Practical Guide to Improving Your Social Intelligence, 2019.
6. Presentation, Persuasion and Public Speaking (Positive Psychology Coaching Series Book, 2015.

Magazine References:

1. The IUP Journal of Soft Skills
2. https.//iupindia.in/softskills.asp
3. Soft Skills Personality Development for Life Success
4. https://reader.magzter.com/preview/4lf6by5blmhou4q0k43xgh4388150/438815

Video References:

1. https://youtube.com/playlist?list=PLLy_2iUCG87CQhELCytvXh0E_ybOO1_q&feature=shared
2. https://youtube.com/playlist?list=PLzf4HhlsQFwJZel_j2Puy0pwjVUgj7KlJ&feature=shared
3. https://m.youtube.com/watch?feature=shared&v=DulsNJtg2L8

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23EM751.1	Understand and apply interpersonal skills to enhance professional interactions and goal-setting.
U23EM751.2	Demonstrate clear and effective communication in reports and presentations to showcase professional skills.
U23EM751.3	Utilize advanced communication techniques to improve verbal and written effectiveness.
U23EM751.4	Analyse team dynamics and personal skills to enhance individual and group performance.
U23EM751.5	Create accurate and concise technical documents to uphold high standards in engineering journalism

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U23MC901	தமிழர் மரபு / Heritage of Tamils	L	T	P	J	C
		1	0	0	0	1

1. Course Description / பாடநெறி விளக்கம்:

This course is taught to provide insight to the students into the rich culture and heritage of the state. The students should know the valued things such as historic buildings that have been passed down from previous generations and relating to things of Tamil historical and cultural value that are worthy of preservation. This course explains the growth of nationalism, the growth of the Tamil language, various religious reformers, the spread of the Dravidian movement and its possible impact on society, the role of the self-respect movement, educational development in Tamilnadu since independence and the growth of fine arts in Tamilnadu.

மாநிலத்தின் வளமான கலாச்சாரம் மற்றும் பாரம்பரியம் பற்றிய நுண்ணறிவை மாணவர்களுக்கு வழங்க இந்த பாடநெறி கற்பிக்கப்படுகிறது. முந்தைய தலைமுறையினரிடமிருந்து பெறப்பட்ட வரலாற்று கட்டிடங்கள் மற்றும் தமிழ் வரலாற்று மற்றும் கலாச்சார மதிப்புள்ள விஷயங்கள் பாதுகாக்கப்பட வேண்டிய மதிப்புமிக்க விஷயங்களை மாணவர்கள் அறிந்து கொள்ள வேண்டும். தமிழ்நாட்டின் தேசியத்தின் வளர்ச்சி, தமிழ் மொழியின் வளர்ச்சி, பல்வேறு சமய சீர்திருத்தவாதிகள், திராவிட இயக்கத்தின் பரவல் மற்றும் சமுதாயத்தில் அதன் தாக்கம், சுயமரியாதை இயக்கத்தின் பங்கு, சுதந்திரத்திற்குப் பிறகு தமிழகத்தில் கல்வி வளர்ச்சி மற்றும் தமிழகத்தில் நுண்கலைகளின் வளர்ச்சி பற்றி இந்த பாடநெறி விளக்குகிறது.

2. Course Objectives / பாடத்தின் நோக்கங்கள்:

1. To make an inference about language and traditional of the state.
   மாநிலத்தின் மொழி மற்றும் பாரம்பரியம் பற்றி அனுமானிக்க உதவுகிறது.
2. To acquire knowledge in construction of status and various musical instruments
   கட்டிடக்கலை மற்றும் பல்வேறு இசைக்கருவிகளை உருவாக்குவதற்கான அறிவைப் பெறுதல்.
3. To study the detailed information about folklore and paramilitary arts.
   நாட்டுப்புறவியல் மற்றும் ராணுவக் கலைகள் பற்றிய விரிவான தகவல்களைப் படிக்க உதவுகிறது.
4. To gain knowledge of rich culture and success history of ancient kingdoms.
   பண்டைய ராஜ்யங்களின் வளமான கலாச்சாரம் மற்றும் வெற்றி வரலாற்றைப் பற்றிய அறிவைப் பெற உதவுகிறது.
5. To acquaint the student with the knowledge of Siddha medicine and about the Indian freedom struggle.

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சித்த மருத்துவம் மற்றும் இந்திய சுதந்திரப் போராட்டம் பற்றிய அறிவை மாணவருக்கு அறிமுகப்படுத்துதல்.

3. Syllabus / பாடத்திட்டங்கள்: **15 Periods**

Unit-I / அலகு-I: Language And Literature / மொழி மற்றும் இலக்கியம் (3)

Language Families in India – Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukkural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.

இந்திய மொழி குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துகள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழிலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

Unit-II / அலகு – II: Heritage–Rock Art Paintings to Modern Art –Sculpture / மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக்கலை (3)

Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils.

நடுக்கல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினை பொருள்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரி முனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, யாழ், வீணை, நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு

Unit-III / அலகு-III: Folk and Martial Arts / நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் (3)

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம் – தமிழர்களின் வீர விளையாட்டுகள்.

Unit-IV / அலகு-IV: Thinai Concept of Tamils / தமிழர்களின் திணைக்கோட்பாடுகள் (3)

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient

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Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas.

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்க கால நகரங்களும் துறை முகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

Unit-V/ அலகு-V: Contribution Of Tamils To Indian National Movement and Indian Culture / இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு (3)

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிற்பகுதியில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுய மரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

Text Books:

1. தமிழக வரலாறு – மக்களும் பயன்பாடுகளும் - கே கே பிள்ளை (தமிழக பாட நூல் கழகம் மற்றும் கல்வியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல .சுந்தரம் (விகடன் பிரசுரம்) .
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளீயீடு).
4. பொருநை -ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils – Dr.K.K.Pillay, A joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils – The Classical Period – Dr.S.Singaravelu (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils – Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture – Dr.M.Valarmathi (Published by: International Institute of Tamil Studies).
9. Keeladi – 'Sangam City Civilization on the banks of river Vaigai' (Jointly published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation Tamil Nadu).
10. Studies in the History of India with Special Reference to Tamil Nadu - Dr.K.K.Pillay.

References:

1. Journey of Civilization Indus to Vaigai – R. Balakrishnan, Published by: RMRL.
2. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

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4. Course Outcomes/ பாடநெறி முடிவுகள்:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome / பாடநெறி முடிவுகள்
U23MC901.1	To know about the language families in India, the impact of the religions, and the contribution of Bharathiar and Bharathidhasan. இந்தியாவில் உள்ள மொழி குடும்பங்கள், மதங்களின் தாக்கம், பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு பற்றி தெரிந்து கொள்வது.
U23MC901.2	Observe the growth of sculpture making of musical instruments and the role of temples in socio and economic lives. தமிழர்களின் வாழ்வில் இசைக்கருவிகள், சிற்பங்களை உருவாக்கும் முறைகள், சமூக, பொருளாதார வளர்ச்சி மற்றும் கோவில்களின் பங்களிப்பு பற்றி அறிந்து கொள்வது
U23MC901.3	Understand the significance of folklore and martial arts. நாட்டுப்புறவியல் மற்றும் தற்காப்புக் கலைகளின் முக்கியத்துவத்தைப் புரிந்து கொள்வது.
U23MC901.4	Learn the Sangam literature, Sangam age and overseas conquest of Cholas. சங்க இலக்கியம், சங்க காலம் மற்றும் சோழர்களின் வெற்றிகள் ஆகியவற்றைக் கற்றுக்கொள்வது.
U23MC901.5	Understand the contribution of Tamils to the Indian freedom struggle and the role of Siddha medicines. இந்திய சுதந்திரப் போராட்டத்தில் தமிழர்களின் பங்களிப்பு, சித்த மருந்துகளின் பங்கு ஆகியவற்றைப் புரிந்து கொள்வது.

SEMESTER II

U23MA203	Linear Algebra	L	T	P	J	C
		3	1	0	0	4

1. Course Description:

This course encompasses matrix theory and linear algebra, focusing on concepts applicable across various disciplines. Linear algebra is a branch of mathematics that studies systems of linear equations and the properties of matrices. The course covers the theory of vector spaces and linear transformations as well as practical methods like diagonalization and row-reduction of matrices that can be used to solve problems in mathematical biology, engineering and economics. It finds widespread use in machine learning for solving linear regression, eigenvalue problems, orthogonalization and matrix inversionand enhancing numerical stability in various algorithms.

2. Course Objectives:

1. Explore about matrix method to solve linear equations.
2. Initiate the basic concepts inthe vector space and its attributes.

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3. Cultivate the knowledge in inner product spaces and its applications.
4. Enhance the knowledge in linear transformations.
5. Inculcate the concept of eigen values and eigen vectors.

3. Syllabus: **45 +15 =60 Periods**

Unit-I: Linear Equations **(9+3)**

System of linear equations: Row reduction, echelon forms, Gaussian elimination method, Gauss Jordan method, LU decomposition, invertibility.

Unit-II: Vector Spaces **(9+3)**

Vector spaces: Subspaces, linear combinations, linear independence and linear dependence, basis and dimensions.

Unit-III: Inner Product Spaces **(9+3)**

Inner product: Norms, Gram-Schmidt orthogonalization process, QR decomposition, least square approximation.

Unit-IV: Linear Transformations **(9+3)**

Linear transformation: Null spaces, ranges, dimension theorem, matrix representation of a linear transformations; Inverse linear transformation.

Unit-V: Eigen values and Eigenvectors **(9+3)**

Eigen values and eigen vectors, Diagonalization: Orthogonal diagonalization; Reduction of quadratic form to canonical form; Singular value decomposition; Principal component analysis.

List of Tutorials:

1. Working procedure, Basic commands and symbolic computation. (CO 1)
2. Solving several types of systems of linear equations. (CO 1)
3. Matrix decomposition - LU decomposition. (CO 1)
4. Shifting and scaling of vectors. (CO 2)
5. Matrix Operations. (CO 1)
6. Matrix decomposition - QR decomposition (CO 3)
7. Least Square method (case study). (CO 3)
8. Eigen values and Eigen vector computation. (CO 5)

Text Books:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", 11th Edition, Wiley India, New Delhi, 2018.
2. Gilbert Strang, Introduction to Linear Algebra, 5th Edition, ANE Books, 2016.

References:

Reference Books:

1. David C Lay, "Linear Algebra and its Applications", 5th Edition, Pearson, New Delhi, 2016.
2. Friedberg, A.H., Insel, A.J. and Spence, L., “Linear Algebra”, 4th Edition, Prentice Hall of India, New Delhi, 2004.
3. Gareth Williams, "Linear Algebra with Applications", Narosa Publishing House, New Delhi, 2012.

Journal References:

1. International Journal of PCA:

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https://www.scirp.org/journal/paperinformation.aspx?paperid=38103
2. International journal of SVD: https://www.sciencedirect.com/topics/engineering/singular-value-decomposition
3. Linear algebra and its applications: https://www.sciencedirect.com/journal/linear-algebra-and-its-applications

Web Resources:

1. https://www.youtube.com/watch?v=JnTa9XtvmfI
2. https://www.khanacademy.org/math/linear-algebra
3. https://www.youtube.com/watch?v=kjBOesZCoqc
4. https://www.youtube.com/watch?v=lUUte2o2Sn8
5. https://www.youtube.com/watch?v=WwQpG9kIdL4

MOOC/NPTEL/SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc22_ma45/preview
2. https://archive.nptel.ac.in/courses/111/101/111101115/
3. https://onlinecourses.nptel.ac.in/noc24_ee48/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23MA203.1	Utilize fundamental concepts of the matrix method for solving linear equations.
U23MA203.2	Implement the principles of vector space and its characteristics to address real time problems.
U23MA203.3	Examine orthonormal basis within inner product spaces.
U23MA203.4	Articulate matrix role as a linear transformation within a finite dimensional space.
U23MA203.5	Discriminating the characteristics of a linear system with eigen values and vectors.

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U23CS401	Data Structures	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

This course provides a comprehensive introduction to data structures. Students will delve into the principles behind organizing and manipulating data efficiently, covering a wide array of topics including lists, stacks, queues, sorting algorithms, searching techniques, hashing, trees, and graphs. Through a combination of theoretical lectures, practical coding exercises, and real-world applications, students will gain a solid understanding of how to select and implement the appropriate data structures and algorithms to solve complex computational problems.

2. Course Objectives:

1. To build and work with linear and nonlinear data structures like arrays, linked lists, stacks, queues, trees, and graphs.
2. To discover data structures to solve real-world problems and scenarios, demonstrating an understanding of trade-offs and limitations
3. To equip students with skills in designing, implementing, and analysing tree-based solutions to complex problems
4. To familiarize and work with algorithms, including traversal, shortest paths, and network flow, to solve complex problems
5. To implement and analyse sorting, searching, and hashing techniques to optimize data retrieval and manipulation in various contexts

3. Syllabus: **45 periods**

Unit-I: Linked Lists **(9)**

Arrays vs Linked list; Linked lists: types, singly linked list, doubly linked list, singly circular linked list, doubly circular linked list, operations, insertion, deletion, find, reverse, modifying linked list; Floyd's cycle finding algorithm: slow pointer and fast pointer

Unit-II: Stacks and Queue **(9)**

Stack: implementation using array and linked list, Operations: push, pop; Applications: infix to postfix conversion, processing function calls; Queue: implementation using array and linked list, enqueue, dequeue, priority queue, circular queue; Applications: call log management

Unit-III: Trees **(9)**

Terminologies; Binary Trees: implementation, traversals, expression trees, cousins of a binary tree; Binary Search Trees: construction, insertion, deletion, searching, find-min, find-max; AVL Trees: insertion, deletion; Priority Queues: heaps; Applications: dictionary, text processing

Unit-IV: Graphs **(9)**

Representation; Types; Traversals: Depth First Search (DFS), Breadth First Search (BFS); Dijkstra's algorithm; Topological sort; Minimum Spanning Tree (MST): Prim's, Kruskal's algorithm; Applications: traffic redirection problem, travelling salesman problem

Unit-V: Sorting, Searching and Hashing **(9)**

Internal sorting: bubble, insertion, quick; External sorting: merge sort; Searching: linear search, binary search; Hashing: hash table, hash functions, collision resolution techniques; Applications: Telephone Directories, Spell Checker, Design of Game Boards

Text Books:

1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2019

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2. Seymour Lipschutz," Data Structures using C", First Edition, McGraw Hill Education, 2017

References:

Reference Books:

1. Narasimha Karumanchi "Data Structures and Algorithms Made Easy" Fifth Edition, Career Monk publications,2023.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2020.

Video References:

1. https://www.geeksforgeeks.org/data-structures
2. https://www.javatpoint.com/data-structure-tutorial
3. https://www.udemy.com/course/datastructurescncpp/

MOOC/NPTEL /SWAYAM Course:

1. https://in.coursera.org/learn/data-structures?action=enroll

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS401.1	Apply the concepts of linked lists by demonstrating an understanding of their implementation and usage to solve given problems
U23CS401.2	Construct stacks and queues using arrays and linked lists and apply these structures to appropriate scenarios
U23CS401.3	Implement tree data structures and their operations to enhance data management and retrieval systems
U23CS401.4	Assess graph-based algorithms to solve complex problems requiring efficient data traversal and manipulation
U23CS401.5	Examine sorting, searching and hashing algorithms to organize and retrieve data effectively

U23PH201	Computational Physics	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

Computational Physics is a foundational course designed to introduce students to the principles governing the equilibrium and motion of bodies under the influence of forces. The course encompasses statics and dynamics, laying the groundwork for further studies in various engineering disciplines. Topics covered include vector analysis, force systems, equilibrium, friction, kinematics, dynamics and the application of these principles to analyse and solve engineering problems. Moreover, this course providing knowledge to students in the analytical tools and problem-solving skills necessary for success in more advanced engineering courses and in professional engineering practice.

2. Course Objectives:

1. To learn the action forces, reaction forces and resultant forces in static bodies for statically determinate structure through scalar and vector approach.
2. To study and determine the properties of surfaces and solids.
3. Understand the principles of kinematic pairs, chains and their classification, DOF, inversions, planar mechanisms
4. Analyse the planar four bar and slider crank mechanisms for position, velocity and acceleration
5. To learn about the fundamentals of friction concepts, force analysis in robots

3. Syllabus:	45 Periods

Unit-I: Statics of Particles and Rigid Bodies **(9)**

Introduction to Mechanics: Units and Dimensions, Laws of Mechanics, Coplanar Forces, Force as 3D Vector; Resolution of Forces: Resultant of Forces, Equilibrium of a particle in space; Types of supports: Action and reaction forces; stable equilibrium; Moments and Couples: Moment of a force about a point and about an axis, Varignon's theorem.

Computer Aided Simulation (For Demonstration Only): Newton's three laws, identify the common forces working on a given object in a given situation, finding the net force acting on an object and identify how it will affect the object; Modeling center of gravity, moment of force and lever arm.

Unit-II: Properties of Surfaces and Solids **(9)**

Centroids and centre of mass: Rectangular, circular, triangular areas, T section, I section, Angle section, Hollow section by using standard formula; Area moments of inertia: simple plane areas

Computer Aided Simulation (For Demonstration Only): Methods of finding centre of gravity of an irregular body; Model a situation for centre of gravity; create an interactive simulation

Unit-III: Fundamentals of Mechanisms **(9)**

Basic Terminology: Kinematic link, Pair, joints, Structure, Machine, Degree of freedom, Grubler& Kutzbach Criterion; Inversions: four bar mechanism, single slider mechanism, double slider mechanism; Mechanical advantage; Transmission Angle.

Computer Aided Simulation (For Demonstration Only):: Planar Mechanisms simulation

Unit-IV: Kinematic Analysis of Mechanisms **(9)**

Relative velocity of kinematic link; Rubbing Velocity of kinematic pair; Coriolis component of acceleration; Construction of velocity and acceleration diagram by graphical method (Relative Velocity Method): Four bar mechanism, slider crank mechanisms; Kinematics of particles: assumptions, cartesian, cylindrical & spherical frames, motion of particles; Translation and rotation of rigid bodies in 2D & 3D.

Computer Aided Simulation (For Demonstration Only)**:**Simulation of Velocity and Acceleration analysis for planar mechanisms

Unit-V: Friction and Fundamentals of Robotics **(9)**

Friction: mechanism, types, Frictional force, Laws of Coulomb friction; Friction analysis: Simple contact friction, Ladder friction, Belt friction, Screw friction; Rolling resistance;

Robotics: Law of robotics, Anatomy, configuration of robots, types of robots, free body diagram of robot configuration, force analysis.

Computer Aided Simulation (For Demonstration Only): Robot programming and simulation for pick and place / machining (cutting, welding); Simple 6-DOF Robot Manipulator Simulation System

Text Books:

1. Beer F P and Johnson E R, —Vector Mechanics for Engineers, Statics and Dynamics, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 11th edition, 2017
2. Mikell P Groover, Mitchell Weiss, Roger N Nagel, Nicholas Odrey, Ashish Dutta "Industrial Robotics (SIE): Technology, Programming and Applications", McGraw Hill Education India., 2012
3. S.S Rattan, Theory of Machines, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2014.

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References:

Reference Books:

1. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics – Statics and Dynamics – Pearson Education Asia Pvt. Ltd., 2014, 4th edition.
2. Arthur P. Boresi, Richard J. Schmidt, Engineering Mechanics Statics and Dynamics– Cengage Learning, 2008, 1st edition.
3. Sadhu Singh, Theory of Machines, Second Edition, Pearson Education, 2012.
4. F.B. Sayyad, "Kinematics of Machinery", MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
5. J. J. Uicker, G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, New York, 2011.
6. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2017.
7. S. K. Saha, Introduction to Robotics, Tata McGraw Hill Education Private Limited, 2008

4. Course Outcomes:

CO. No.	Course Outcome
U23PH201.1	Solve the scalar and vector representation of forces and analyze the behaviour of particles in equilibrium conditions.
U23PH201.2	Analyze the properties of surfaces and solids.
U23PH201.3	Identify the simple mechanisms based on given application
U23PH201.4	Find velocity and acceleration of simple mechanisms.
U23PH201.5	Determine the frictional force & its effects by using laws of friction and understand the fundamentals of force analysis in robots.

U23CS402	Object Oriented Programming using C++	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

This course serves as an intensive exploration of the principles and practices of object-oriented programming (OOP) using the C++ programming language. Students will embark on a journey through the core concepts of OOP, including classes and objects, inheritance, polymorphism, and dynamic memory allocation. Additionally, the course will delve into advanced topics such as the Standard Template Library (STL), lambda expressions, and concurrency. Through hands-on coding exercises, projects, and real-world examples, students will gain a solid understanding of how to design, implement, and maintain object-oriented C++ programs efficiently.

2. Course Objectives:

1. Teach students the foundational principles of C++ programming.
2. Instruct students on the core concepts of Object-Oriented Programming (OOP) in C++.
3. Guide students in understanding and applying inheritance and polymorphism in C++.
4. Enable students to implement common data structures and containers using C++.
5. Train students in developing concurrent applications using C++.

3. Syllabus: **45 periods**

Unit-I: Foundations of C++ **(9)**

Introduction to C++: features, identifiers, data types, namespace, keywords, operators, input & output, streams, control statements; arrays; strings; functions: inline functions, default arguments; references & pointers; dynamic memory management

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Unit-II: Classes and Objects	**(9)**
OOP Mechanisms: classes and objects, access specifiers, constructors, destructors & object lifetime, copy constructor & copy assignment operator; static members; structs & enumeration; friend function & friend class	
Unit-III: Inheritance and Polymorphism	**(9)**
Inheritance & its types; aggregation; abstract classes; polymorphism: static and dynamic binding, virtual function table, function overloading, operator overloading; type casting: cast operators	
Unit-IV: Standard Template Libraries	**(9)**
STL: components: containers, algorithms, functions, iterators; containers: array, vector, deque, list, forward list, stack, queue, set, multiset map, multimap, unordered set, unordered multiset, unordered map, unordered multimap; file handling	
Unit-V: Lambda and Concurrency	**(9)**
Exception & its types; concurrency: atomic, thread, mutex; lambda in C++; resource management by smart pointers; C++ series: rvalue, lvalue & perfect forwarding; templates in C++ : features & types	

Text Books:

1. C++20 – The Complete Guide by Nicolai M. Josuttis, 2022
2. C++: The Complete Reference by Herbert Schildt,4th Edition,2017

Reference Books:

1. Modern C++ Tutorial: C++11/14/17/20 On the Fly by Changkun Ou, 2023
2. Effective Modern C++: 42 Specific Ways to Improve Your Use of C++11 and C++14 by Scott Meyers, 2015

Web References:

1. https://cplusplus.com/
2. https://google.github.io/styleguide/cppguide.html

MOOC/NPTEL /SWAYAM Courses:

1. https://www.udemy.com/course/cpp-deep-dive
2. https://onlinecourses.nptel.ac.in/noc23_cs78/course
3. https://onlinecourses.nptel.ac.in/noc21_cs02/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS402.1	Demonstrate problem-solving skills by writing C++ programs for simple applications
U23CS402.2	Design and implement simple classes with attributes, methods and appropriate access modifiers
U23CS402.3	Illustrate the concepts of inheritance and polymorphism in real-time objects
U23CS402.4	Evaluate and choose the appropriate STL (vectors, lists, maps, etc.) for real-time applications
U23CS402.5	Apply the modern concepts of C++ in real-time concurrent processing

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U23NCC01	NCC Credit Course Level I	L	T	P	J	C
		2	0	0	0	2

1. Course Description:

The NCC Course is designed to instil discipline, leadership, and a sense of social responsibility in participants. Through a blend of theory and practical activities, students learn to respect cultural diversity, manage time effectively, and handle stress efficiently. They develop teamwork skills and engage in social service initiatives, fostering a well-rounded approach to personal and community development.

2. Course Objectives:

1. Provide a comprehensive understanding of the NCC's structure and objectives.
2. Foster national integration and the NCC's role in nation-building.
3. Develop leadership and personality development skills.
4. Encourage active participation in social service and community development.
5. Enhance awareness of safety protocols and key government initiatives.

3. Syllabus: **30 Periods**

Unit-I: NCC General **(5)**

Aims, Objectives & Organization of NCC – Incentives – Duties of NCC Cadet – NCC Camps: Types & Conduct

Unit-II: National Integration and Awareness **(5)**

National Integration: Importance & Necessity – Factors Affecting National Integration – Unity in Diversity & Role of NCC in Nation Building – Threats to National Security

Unit-III: Personality Development **(6)**

Self-awareness, Empathy, Critical & Creative Thinking, Decision-making and Problem-Solving – Communication Skills – Group Discussion: Stress & Emotions, Time Management, Team Work – Career Counseling, SSB Procedure & Interview Skills – Public Speaking

Unit-IV: Leadership **(7)**

Traits, Indicators, Motivation, Moral Values, Honour code – Case Studies: Shivaji, Jhansi Ki Rani, APJ Abdul Kalam, Tippu Sultan, Rabindranath Tagore, Ratan Tata

Unit-V: Social Service and Community Development **(7)**

Basics – Rural Development Programmes, NGOs, Contribution of Youth – Swachh Bharat Abhiyan – Drug Abuse, Tree Plantation Traffic Awareness, Digital Awareness, Beti Padhao Beti Bachao, Women Health & Sanitation – Protection of Children and Women Safety – Road / Rail Travel Safety – New Initiatives – Cyber and Mobile Security Awareness

Text Book:

1. National Cadet Corps "Cadets Hand Book – Army(Common Subjects)"

Web Reference:

1. https://indiancc.nic.in/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23NCC01.1	Demonstrate the conduct of NCC cadets, exhibiting discipline and leadership qualities, respect and appreciate the diversity of Indian culture, and fostering a sense of unity amidst differences.

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U23NCC01.2	Conduct a comprehensive SWOT analysis to identify personal strengths and weaknesses, and implement strategies to overcome weaknesses, enhancing overall performance.
U23NCC01.3	Utilize various strategies for stress management, ensuring mental well-being and resilience in challenging situations
U23NCC01.4	Collaborate effectively within a team, demonstrating teamwork skills to achieve common objectives.
U23NCC01.5	Engage in social service activities on different occasions, contributing positively to the community and fostering a sense of social responsibility

U23HS581	**Business English**	**L**	**T**	**P**	**J**	**C**
		2	**0**	**2**	**0**	**3**

1. Course Description:

This course is designed to make the learners understand the importance and scope of Business Communication. The Learners will be introduced to a range of various situations, which will enable them to utilize the business terms profusely. It also enhances their competency to emerge successfully in the corporate world. Further, this course will enable them to do effective presentations by gathering relevant information, determining audience needs and defining presentation purpose.

2. Course Objectives:

1. Develop strategies and skills to enhance their ability to read and comprehend business communication.
2. Strengthen their listening skills which will help them to perform effectively in the business world.
3. Develop their speaking skills to analyse and respond appropriately.
4. Foster their ability to excel in written business communication.
5. Build their confidence to participate in business meetings and interviews.

3. Syllabus: **30+30=60 Periods**

Unit-I: Introduction to Business Communication **(6)**

Basics of Business Communication – Types of Business Communication: Internal and External – The Communication Process and Barriers – Business Vocabulary: Common Terms and Phrases; Grammar: Sentence Structure and Types of Sentences – Punctuation in Business Writing; Listening: Listening to business conversations and identifying key information; Speaking: Role-play exercises simulating business meetings and phone calls; Reading: Analysing business emails and memos; Writing: Drafting professional emails and business letters.

Unit-II: Business **(6)**

Writing Business Emails, Memos, and Letters – Writing Reports and Proposals – Creating Agendas and Minutes of Meetings; Grammar: Active and Passive Voice – Modal Verbs for Politeness and Formality; Listening: Listening to sample business discussions and note-taking; Speaking: Presenting ideas and reports in meetings; Reading: Reading and analysing business proposals; Writing: Composing various forms of business correspondence.

Unit-III: Negotiation and Persuasion **(6)**

Techniques of Persuasion in Business – Negotiation Strategies and Tactics – Understanding Cultural Differences in Negotiation – Conflict Resolution and Handling Objections; Grammar: Conditional Sentences in Business Scenarios – Use of Conjunctions and Linking

Words; Listening: Listening to negotiation dialogues and identifying key tactics; Speaking: Role-playing negotiation scenarios; Reading: Analysing case studies on successful negotiations; Writing: Drafting negotiation emails and proposals.

Unit-IV: Presentations and Public Speaking **(6)**

Planning and Structuring Business Presentations – Using Visual Aids Effectively – Public Speaking Techniques – Handling Q&A Sessions; Grammar: Use of Cohesive Devices and Transitions – Clauses of Reason, Purpose, and Result; Listening: Listening to business presentations and taking notes; Speaking: Delivering business presentations; Reading: Reviewing presentation slides and materials; Writing: Preparing presentation scripts and speaker notes.

Unit-V: Business Reports and Documentation **(6)**

Writing and Structuring Business Reports – Writing Executive Summaries – Creating Business Plans – Documenting Processes and Procedures; Grammar: Complex Sentence Structures – Use of Passive Voice in Reports – Reported Speech in Business Contexts; Listening: Listening to report summaries and identifying main points; Speaking: Presenting a summary of a business report; Reading: Analyzing business reports and identifying key sections; Writing: Drafting business reports and executive summaries.

List of Exercises: **(30)**

1. Listening to business conversations and identifying key information. (CO 1)
2. Role-play exercises simulating business meetings and phone calls. (CO 2)
3. Listening to sample business discussions and note-taking. (CO 2)
4. Presenting ideas and reports in meetings. (CO 4)
5. Listening to negotiation dialogues and identifying key tactics. (CO 3)
6. Role-playing negotiation scenarios. (CO 3)
7. Listening to business presentations and taking notes. (CO 4)
8. Delivering business presentations. (CO 4)
9. Listening to report summaries and identifying main points. (CO 5)
10. Presenting a summary of a business report. (CO 5)

Text Books:

1. Business Communication: Building Critical Skills by Kitty O. Locker and Stephen Kyo Kaczmarek, McGraw-Hill Education.
2. Business Communication Today by Courtland L. Bovee and John V. Thill, Pearson.

References:

Reference Books:

1. Essentials of Business Communication by Mary Ellen Guffey and Dana Loewy, Cengage Learning.
2. The Business Communication Handbook by Judith Dwyer, Pearson Australia.
3. Technical Communication: A Reader-Centered Approach by Paul V. Anderson, Cengage Learning.
4. Guide to Managerial Communication: Effective Business Writing and Speaking by Mary Munter and Lynn Hamilton, Pearson.
5. Effective Business Writing: Strategies, Suggestions and Examples by Maryann V. Piotrowski, HarperCollins Publishers.

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Video References:

1. https://www.youtube.com/watch?v=V8uF1EoIneE
2. https://www.youtube.com/watch?v=moIucWGgvMc
3. https://www.youtube.com/watch?v=o9aVjBHEEbU

Web Resources:

1. https://learnenglish.britishcouncil.org/business-english
2. https://research.com/education/useful-links-for-learning-and-teaching-english-and-teaching
3. https://www.talaera.com/learn/
4. http://www.perfectyourenglish.com/grammar/numeral-adjectives.htm
5. https://en.wikipedia.org/wiki/Commonly_misspelled_English_words
6. https://www.englisch-hilfen.de/en/grammar/if.htm
7. http://www.englishforeveryone.org/Topics/Reading-Comprehension.htm

MOOC/ SWAYAM / NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc22_hs05/preview
2. https://onlinecourses.nptel.ac.in/noc23_hs72/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23HS581.1	Develop fundamental professional communication skills to effectively navigate and overcome barriers in business conversations.
U23HS581.2	Construct professional emails, memos, and letters, and draft formal business reports and proposals.
U23HS581.3	Develop skills in negotiation and persuasion, recognize cultural differences, and use conflict resolution strategies in business.
U23HS581.4	Plan and deliver well-structured business presentations with effective visual aids.
U23HS581.5	Build organized business reports, executive summaries, and documentation with precision and clarity.

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U23HS501	Basic Japanese	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

The primary objective of this course is to provide a solid foundation in speaking, listening, reading, and writing Japanese. Through interactive lessons and practical exercises, you'll learn essential vocabulary, grammar structures, and pronunciation. Additionally, this course will introduce the various facets of the Japanese culture with cultural insights and real-life scenarios, thereby enhancing their awareness of the cultural subtleties inherent in the language.

2. Course Objectives:

1. Develop proficiency in basic Japanese language skills including speaking, listening, reading and writing to facilitate effective communication in everyday situations.
2. Acquire a solid understanding of the fundamental Japanese grammar structures, vocabularies and pronunciations to construct simple sentences and engage in basic conversations.
3. Enhance language proficiency through interactive activities, role-plays and real-life scenarios, fostering practical language usage and confidence in communication.
4. Build a foundation for further language study and cultural exploration, enabling the students to pursue advanced language proficiency and deeper cultural understanding.

3. Syllabus: **45 Periods**

Unit-I: Introduction to Japanese Scripts and Basic Greetings (9)

Japanese Scripts (Hiragana & Katakana) – Daily greetings and expressions – Introduction to grammar particles – N1 wa N2desu – N1 wa N2ja arimasen – Phrase/Sentence ka – N1 mo N2desu – N1 no N2desu – Honorific suffixes (san, kun, chan) – Demonstrative words (Ko, So, A & Do series) – Soudesu – Soudesuka – Soudesune – Sou ja arimasen/Chigaimasu – S1 ka S2 ka – N1(noun) wa N2(place)desu – Numbers – Days of the week – Days of the month

Unit-II: Introduction to Concept of Time (9)

Ji, fun, pun – Ima wa nan ji desuka – Introduction to verbs (group I, group II, group III verbs) – Verb tense forms – V masu – V mashita – V masen – V masendeshita – N(time) ni V – N1 kara N2made – N1 to N2– N to V – S ne – N(place) e ikimasu/kimasu/kaerimasu – Doko(e) mo ikimasen/ikimasendeshita – itsu – S yo – Introduction to de particle – N(place) de V – N(vehicle) de ikimasu/kimasu/kaerimasu – N(tool) de V – N o V(transitive) – N o Shimasu – Usage of nan and nani – V masenka – V mashou, mashouka – Honorific prefixes(o/go) – "word/sentence" wa ~go de nan desuka – N(person) ni agemasu/moraimasu/kuremasu – V mou mashita.

Unit-III:Introduction to Adjectives (9)

I ending adjectives – na ending adjectives – forms of adjectives(negative form, past form) – I ending adjective →ku/Na ending adjective→ni narimasu – degrees of adjectives – S1 ga S2 – N ga adjective – N ga arimasu/wakarimasu – degrees of adverbs – degrees of quantity – S1 kara S2 – Doushite – N1(place) ni N2(noun) ga arimasu – N1(noun) wa N2(place) ni arimasu/imasu – N1(noun) no N2(position) – N1 ya N2 nado.

Unit-IV:Introduction to Counters (9)

Counters for objects – Counters for person – Ikutsu – nan+counter suffix – kurai and gurai – Quantifier(period) ni frequency counter(kai) – Quantifier/Noun+dake – N1 wa N2 yori "adjective" desu – N1 to N2to Dochira ga "adjective" desuka – N no naka de nani/doko/dare/itsu ga "adjective" desuka – Interrogatives ka/mo/demo.

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Unit-V: Verb Conjugations and their Usages **(9)**

5.1: V masu form and its usages

N ga hoshii desu – V masu form tai desu – V masu form ni ikimasu/kimasu/kaerimasu – V masu form mashouka.

5.2: V te form and its usages

V te form kudasai – V te form imasu – V te form mo iidesu – V te form wa ikimasen – shirimasu, shirimasen, shitte imasu – te form of adjectives – V1 te form kara V2 – douyatte – V te form agemasu/kuremasu/moraimasu

5.3: V nai form and its usages

V nai form de kudasai – V nai form kereba narimasen – V nai form to – V nai form kutemo iidesu – N(time) madeni V.

5.4: V dictionary form and its usages

V dictionary form koto ga dekimasu – Shumi wa N suru/V dictionary form koto desu – N no/Quantifier(time)/V1 dictionary form maeni V2 – nakanaka – zehi/zettai/mochiron – V dictionary form jikan/youji/yakusoku.

5.5: V ta form and its usages

V ta form koto ga arimasu – V ta ri, V ta ri Shimasu – usage of plain form and polite form – kedo – noun modification using V plain form – V plain form/N no toki ~.

5.6: If clause

V dictionary form to~ - V ta form ra~ - V te form/I adj→kute/Na adj→de/N de mo~ - moshi/ikura~.

Text Books:

1. Minna no Nihongo, Japanese for Everyone: Elementary main textbook 1-1 & 1-2". 1st edition, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. "Basic Kanji 320", published by Meguro Language Centre, Tokyo.

References:

Reference Books:

1. Genki: An Integrated Course in Elementary Japanese, Eri Banno, Yoko Ikeda, and Yutaka Ohno, , The Japan Times, 2011.
2. Nihongo So-matome: JLPT N5 grammar" authored and published by Ask Publications, 2021 edition.

Web Resources:

1. www.japaneselifestyle.com
2. www.learn-japanese.info/
3. www.kanjisite.com/
4. www.learn-hiragana-katakana.com/typing-hiragana-characters/

4. Course Outcomes

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23HS501.1	Recognize and write the Japanese alphabet without errors
U23HS501.2	Extend the conversation using basic sounds in the Japanese language
U23HS501.3	Explain the concept of time by learning verbs, tenses and vocabularies.
U23HS501.4	Make use of the appropriate vocabulary required for simple conversations in the Japanese language.
U23HS501.5	Comprehend the conversation and give the correct meaning

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U23HS502	Basic German	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

This German language course offers a structured approach to learning German, spanning from basic introductions to more complex grammatical concepts and practical applications. Beginning with an introduction to German scripts and daily greetings, participants progress through units covering essential grammar topics, vocabulary expansion, and pronunciation exercises. Throughout the course, students engage in speaking activities, such as introducing themselves, ordering food, and describing their surroundings, while also focusing on listening comprehension and reading comprehension.

By the end of the course, participants will have gained proficiency in basic conversational German, acquired foundational knowledge of German grammar and vocabulary, and developed the skills necessary to navigate everyday situations in a German-speaking environment.

2. Course Objectives:

1. Basic German introduces learners to essential language components such as vocabulary, grammar, pronunciation, and basic conversational phrases.
2. Through interactive lessons and practical exercises, students develop the ability to communicate in basic German for everyday scenarios including greetings, introductions, shopping, dining, and navigating daily life situations.
3. Additionally, learners become familiar with the German alphabet, basic sentence structure, and common expressions, facilitating basic reading and writing skills.

3. Syllabus: **45 Periods**

Unit-I: Basic Introduction to German Scripts **(9)**

Theme and Text (Introduction to German – German script, Deutsche Namen, Daily Greetings and Expressions) – Grammar ('wh' questions, das Alphabet)– Speak Action (Buchstabieren, sich und andere vorstellen nach Namen und Herkunft fragen, internationale Wörter auf Deutsch verstehen, jemanden begrüßen)– pronunciation (Buchstabieren J,V,W,Y, - Long vowels A,E,I,O,U – Pronunciation of Ä,Ü,Ö) – To learn (internationale Wörter in Texten finden, Wörter sortieren)

Theme and Text (Gespräche im caf'e, Getränkekarte, Telefon-buch, Namen, Rechnungen) – Grammar (Frägesatze mit wie, woher, wo, was Verben in präsens Singular und Plural, das Verb Sein, Personalpronomen und Verben)– Speak Action (eine Gespräch beginnen sich und andere vorstellen zählen, etwas bestellen und bezhalen Telefonnummern und verstehen)– pronunciation (Wortakzent in Verben und in Zahlen) – To learn (Grammatiktabelle ergänzen, mit einem Redemittelkasten arbeiten)

Unit-II: Numbers and Nominative Case **(9)**

Theme and Text (Numbers – 1 to 12 (Eins bis Zwolf) – 20, 30, 40, 90 (zwanzig-Neunzig) – All Numbers (1-10000) – German Currency (Euro) – Basic Mathematics (plus, Minus, Malen, Geteilt durch)) – Grammar (Introduction of verbs –Have Verb – To Come, To Speak, To Read, To Drive, To Fly, To write, To Eat, To sleep, To take etc.,)

Theme and Text (Communication in course) – Grammar (Singular and Plural, Artikel: der,das,die/ ein,eine, verneinung: kein, keine, Komposita: das Kursbuch) – Speak Action (Gegenständen fragen/ Gegenstände benennen im kurs☺ – pronunciation (word accent Marking, Umlaute ö ä ü hören und sprechen) – To learn (Lernkarten schreiben, Memotipps, eine Regel selbst finden)

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Theme and Text (City, Town, Language: Nachbar, Sprachen, Sehenswürdigkeiten in Europa) – Grammar (Past tense for Sein, W-Frage, Aussagesatz und Satzfrage) – Speak Action (about city and siteseeing) – pronunciation (Satzakzent in Frage- und Aussagesätzen) – To learn (eine Regel ergänzen, eine Grammatiktabelle erarbeiten, Notizen machen)

Unit-III:Akkusative Case and Prepositions (9)

Theme and Text (Menschen und Hauser, Furniture catalogue, E-Mail, House information) – Grammar (possesivartikel im Nominativ, Artikel im Akkusativ, Adjektive im satz, Graduierung mit zu)– Speak Action (Whonung bescreiben about perons and things)– pronunciation (consonant – ch) – To learn (wortschatz systematisch)

Theme and Text (Termine – Appointment and punctuality in Germany) – Grammar (questions with wann?, Preposition (am, um, von… bis), verneinung mit nicht, trennbare verben, präteritum von haben) – Speak Action (Daily plan making, time commitment, excuse for late coming) – pronunciation (consonants- p,b,t,d / k,g) – To learn (Rollenkarten arbeiten)

Theme and Text (orientation in the working area, go for work, floor plan city plan, office and computer) – Grammar (preposition: in,neben, unter, auf, vor, hinter, an, zwischen, bei und mit + Datic)– Speak Action (workplace, work, giving appointments)– pronunciation (consonants: f,w und v) – To learn (Making notice in the calendar)

Unit-IV:Dativ Case and Prepositions (9)

Theme and Text (Holiday and Party, holiday plan, party plan in Germany) – Grammar (regular and irregular verbs) – Speak Action (holiday speak, accident, Ich-Text schreiben) – pronunciation (lange und kurze vokale markieren) – To learn (Text Order)

Theme and Text (organising an Excursion to Berlin through city orientation, Bus plan, City plan, postcard, Excursion programme) – Grammar (preposition: in, durch, über + Akkusativ: zu, an… vorbei + Dativ, Modalverb wollen) – Speak Action (Tourism, culture, postcard preparation, travel description) – pronunciation (r and l)– To learn (plaket making)

Theme and Text (Beruf und all Tag, Visiten karten, wörterbuch) – Grammar – Speak Action (profession, statistic speaking) – pronunciation (n,ng and nk)– To learn (wörterbuch , text information in tabel)

Unit-V: Adjectives and Pronunciation (9)

Theme and Text (Haushaltstipp, kochrezept, maße und gewichte, Mahlzeiten und Gerichte) – Grammar (jeden Tag, manchmal, nie, Question – welche, Comparison – viel, gut, gern) – Speak Action (about eat, drink question and answers) – pronunciation (e,en,el,er) – To learn (Text auswerten und zusammenfassen)

Theme and Text (Clothing , colour, weather) – Grammar (Adjecktive im Akkusativ, unbestimmer Artikel) – Speak Action (weather, dress and colour understanding) – pronunciation (e-o- ö and ie-u- ü) – To learn (wetter and Farben interkulturelle)

Theme and Text (in supermarket,purchase, House Maintenance, Emotions, Sports, Body parts) – Grammar (Modal Verb) – Speak Action (Body parts) – To learn (Rollenkarten arbeiten)

Text Books:

1. Funk, Kuhn, Demme, "Studio D A1 Deutsch als Fremdsprache" Goyal Publishers and Distributors; 2016
2. Hueber, "Fit for Goethe- Zertifikat A1 (Start Deutsch 1)" Goyal Publishers and Distributors; 2016

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References:

Reference Books:

1. Stefanie Dengler, "Netzwerk Deutsch Als Fremdsprache A1" by Goyal Publishers & Distributors Pvt Ltd
2. Fran Martin, "Grammar Tables for Student of German" by Independently Published, 2017

Web Resources:

1. www.memrise.com/courses/english/german/
2. www.deutsch-lernen.com/
3. www.duolingo.com

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23HS502.1	Recognize and write the German alphabet
U23HS502.2	Speak using basic sounds of the German language
U23HS502.3	Apply appropriate vocabulary needed for simple conversation in the German language
U23HS502.4	Apply appropriate grammar to write and speak in the German language
U23HS502.5	Comprehend the conversation and give the correct meaning

U23AD481	Python for AI	L	T	P	J	C
		2	0	2	2	4

1. Course Description:

This course equips students with essential skills in Python programming tailored for applications in Artificial Intelligence (AI). Through a combination of theoretical learning and hands-on practice, students will gain proficiency in leveraging Python's capabilities to address real-world challenges in various domains. The course covers fundamental concepts of Python programming, explores data structures, delves into object-oriented programming, and introduces scientific computing and Natural Language Processing (NLP) techniques.

2. Course Objectives:

1. To gain mastery in Python fundamentals tailored for AI applications.
2. To effectively employ various data structures within Python for AI tasks.
3. To adeptly apply object-oriented programming principles to the design and implementation of AI systems.
4. To proficiently analyze and extract insights from textual data through the application of NLP techniques within Python.
5. To develop the skills necessary to tackle real-world AI challenges using Python as the primary toolset.

3. Syllabus: **30+30+30 = 90 Periods**

Unit-I: Introduction to Python **(6)**

Python basics: Introduction, IDE, identifiers, keywords; variables and expressions, literals, comments, I/O statements; Operators: arithmetic, relational, logical, assignment, bitwise, identity and membership operators; Conditional statements: if, else, and elif statements; Iteration: for, while, while-else; String operations: indexing, slicing, concatenation; File handling: open and close files, read, write and delete files.

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Unit-II: Python Data	**(6)**
Basic data-types, mutability; List: Introduction to list, accessing list, list operations, aliasing and cloning, list as arrays; Tuples: Introduction to tuple, accessing tuples, tuple operations; Dictionary: Introduction to dictionaries, operations and methods; Set: Creating sets, performing set operations: union, intersect and difference.	
Unit-III: Functions and Object-Oriented	**(6)**
Python functions: Function definition, function call, variable scope, types, arguments, lambda functions. Recursive function; Object Oriented Programming: Class, object, attributes, methods, methods vs functions, constructor, encapsulation, inheritance, abstraction, polymorphism; exception handling.	
Unit-IV: Scientific Computing with Numpy, Pandas and Matplotlib	**(6)**
Modules and packages: Introduction; Numpy Library: Numpy basics, indexing and slicing, shape manipulation, array iteration, array join and split, search, sort, filter; Pandas Library: Pandas introduction, series, dataframe, grouping, merging, filtering, list comprehension, concatenating and transforming data; Matplotlib Library: Line plot, scatter plot, histogram, bar plot and subplots.	
Unit-V: Natural Language Processing (NLP) and Data Mining	**(6)**
NLP: Introduction, NLTK, textblob, tokenization, stemming and lemmetization, stopwords, visualising word frequency using pandas and wordclouds, spaCy, applications; Data mining in Twitter: Overview, introduction to tweepy cursors, pre-processing, API, tweet sentiment analysis, geocoding and mapping.	
List of Experiments:	**30 Periods**

1. Design a Python program that can perform basic arithmetic operations and scientific functions such as square root, exponentiation and trigonometric functions. (CO 1)
2. Apply Python's regular expressions to efficiently identify and tally the occurrences of targeted words within a provided text document, facilitating precise text parsing and analysis. (CO 1)
3. Develop a Python program using basic datatypes that manages a student database, allowing users to add, update, delete, and search for student records. (CO 2)
4. Analyze a dataset containing user preferences and identify common preferences among users using python sets. (CO 2)
5. Design a library management system in Python using classes to represent books, users, and transactions, and implement methods for borrowing and returning books. (CO 3)
6. Compare the performance of recursive and iterative solutions for calculating factorials in Python, and analyze the results in terms of execution time and memory usage. (CO 3)
7. Develop a Python tool for data analysis using Numpy to calculate statistical measures in a dataset. (CO 4)
8. Analyze historical stock market data using Pandas to identify trends and patterns, and visualize the trends using Matplotlib. (CO 4)
9. Develop a sentiment analysis tool in Python using NLTK to analyze the sentiment of product reviews and evaluate the accuracy of the classifier. (CO 5)
10. Design a Python program to generate a word cloud visualisation from a given text corpus, highlighting the most frequent words. (CO 5)
11. Develop a Python program that fetches tweets related to a specific topic using the Twitter API, performs sentiment analysis on the retrieved tweets, and visualizes the sentiment distribution. (CO 5)

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Projects:	**30 Periods**
Projects in the area of data science and machine learning using Python for real time applications. (CO 1 to CO 5)	

Text Books:

1. Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press 2018.
2. Paul Deitel, Harvey Deitel,"Python for Programmers with introductory AI case studies", Pearson Education, 2019.
3. Anurag Gupta, G.P. Biswas, "Python Programming: Problem Solving, Packages and Libraries", McGrawHill, 2020.
4. John V. Guttag, "Introduction to Computation and Programming Using Python", 2nd edition, The MIT Press, 2016.
5. Guido van Rossum and Fred L. Drake Jr," An Introduction to Python - Revised and updated for Python 3.2", Network Theory Ltd., 2011.
6. Liang Y. Daniel, "Introduction to Programming Using Python",Pearson Education, 2017.

References:

Reference Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
5. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

Web Resources:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://greenteapress.com/wp/think-python/
3. https://www.docs.python.org

MOOC/NPTEL/SWAYAM Courses:

1. https://nptel.ac.in/courses/106106212
2. https://nptel.ac.in/courses/110107129
3. https://nptel.ac.in/courses/106107220
4. https://nptel.ac.in/courses/106/106/106106182/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS382.1	Apply the concepts of python programming for solving real-world problems.

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U23CS382.2	Develop python programs that effectively utilize built-in data structures to address practical challenges encountered in various applications.
U23CS382.3	Analyze complex problems and develop modular and reusable solutions by applying python functions and classes.
U23CS382.4	Analyze data and visualize trends Using Numpy, Pandas, and Matplotlib libraries.
U23CS382.5	Analyze textual data from social media platforms using advanced NLP techniques.

U23CS451	Data Structures Laboratory	L	T	P	J	C
		0	0	4	0	2

1. Course Description:

The Data Structure Laboratory is a hands-on course designed to complement theoretical knowledge with practical implementation skills in data structures. Through a series of lab sessions, students will work on implementing code and projects focusing on lists, stacks, queues, sorting algorithms, searching techniques, hashing, trees and graph data structures. By actively engaging in coding exercises and projects, students will deepen their understanding of the course, enhance their programming skills, and gain valuable experience applicable across various computer science and engineering domains.

2. Course Objectives:

1. To build and work with linear and nonlinear data structures like arrays, linked lists, stacks, queues, trees, and graphs.
2. To discover data structures to solve real-world problems and scenarios, demonstrating an understanding of trade-offs and limitations
3. To equip students' skills in designing, implementing, and analyzing tree-based solutions to complex problems
4. To familiarize and work with algorithms, including traversal, shortest paths, and network flow, to solve complex problems
5. To implement and analyze sorting, searching, and hashing techniques to optimize data retrieval and manipulation in various contexts

3. List of Experiments: **60 Periods**

1. Develop a Multimedia Library Management System that organizes and manages various types of multimedia content such as audio, video, and images. Each type of content requires a different approach for efficient management. Choose a suitable linked list operation for each multimedia category's specific needs. (C01)
2. Demonstration of applications of Linked List (Reversal Problems, Segregation of Even and Odd nodes in Linked List, Palindrome checking using Linked List, Loop Detection, Sorting the bitonic using doubly linked list) (CO1)
3. Build a critical software project for a large healthcare organization that processes and manages a high volume of patient data, requiring efficient and reliable data structures for task management, resource allocation, and communication. Select appropriate data structures (stacks and queues) for specific use cases, considering their performance characteristics, flexibility, and memory usage. (C02)
4. Demonstration of applications of Stack and Queue (Evaluating Postfix Expressions, Infix to Postfix conversion, Balancing symbols and Postfix evaluation, Wild card pattern matching(CO2)

5. Develop a movie recommendation system for a popular streaming platform that recommends movies to users based on their past watching history and preferences. Use a binary tree data structure to store and search for movies based on different criteria efficiently. (CO3)
6. Build an online bookstore with a vast collection of books to manage the inventory efficiently and provide a seamless user experience with the help of a Binary Search Tree (BST) data structure.(CO3)
7. Demonstration of applications of Trees (Segment Tree and Range Minimum Query on the Constructed Segment Tree, Maximum depth of Binary tree) (CO3)
8. Design a network for any food delivery partner to understand how people are connected, and how information flows through the network and identify influential users using graph traversal algorithms. (CO4)
9. Construct a travel management system that aims to streamline the planning and organization of travel itineraries for a travel agency. The system utilizes various graph algorithms (Topological Sort, Connected Graph and Ticket Itinerary) to efficiently manage the complexities of travel planning. (CO4)
10. Design a food delivery app for a bustling city. Thousands of orders flow daily, and ensuring fast and efficient delivery is crucial for customer satisfaction. Use Dijkstra's algorithm to find the shortest paths for delivery drivers, optimizing their routes and minimizing delivery times.(CO5)
11. Design an optimized network infrastructure of an organization that connects the various departments within the organization using the minimum amount of cabling to reduce costs and enhance network efficiency. Implement Prim's and Kruskal's algorithms for finding the Minimum Spanning Tree (MST) for the network. (CO5)
12. Create a Student Grade Management System for a university that efficiently organizes and displays student grades for various courses. The system should employ different sorting algorithms to cater to diverse requirements and optimize the display of grades. Choose the suitable sorting algorithms (Bubble Sort, Insertion Sort, Quick Sort, Merge Sort) for quick grade overview, mark entry, course ranking and overall grade report. (CO5)
13. Develop a Product Inventory Management System for a retail company that handles a large number of products to implement efficient searching techniques to retrieve information about products in the inventory quickly. Select the appropriate searching technique (Linear Search, Binary Search) for quick product lookup, inventory sorting, and retrieval. (CO5)
14. Demonstration of applications of hashing (Single swap sorted array, Anagram Checking and Range Minimum Query Using Sparse Table, Merge two sorted arrays) (CO5)

References Books:

1. Reema Thareja, “Data Structures Using C”, Second Edition, Oxford University Press, 2019
2. Narasimha Karumanchi “Data Structures and Algorithms Made Easy” Fifth Edition, Career Monk publications,2017
3. Seymour Lipschutz, “Data Structures using C”, First Edition, McGraw Hill Education, 2017

Web Resources:

1. https://www.geeksforgeeks.org/data-structures
2. https://www.javatpoint.com/data-structure-tutorial

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MOOC/NPTEL /SWAYAM Courses:

1. https://www.udemy.com/course/datastructurescncpp/
2. https://in.coursera.org/learn/data-structures?action=enroll

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS451.1	Solve Problems by applying the concepts of Linked Lists
U23CS451.2	Implement Stacks and Queues with Array and LinkedList and solve problems with Stacks and Queues
U23CS451.3	Implement tree data structures and demonstrate tree operations such as insertion, deletion, traversal and balancing
U23CS451.4	Implement the graph-based algorithms to solve complex problems requiring efficient data traversal and manipulation
U23CS451.5	Apply sorting, searching and hashing algorithms to organize and retrieve data effectively

U23CS452	Object Oriented Programming using C++ Laboratory	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

Object-Oriented Programming (OOP) Using C++ Laboratory is a practical course aimed at reinforcing theoretical concepts through implementation and real-world applications. Students will engage in coding assignments and projects focusing on core OOP principles, including inheritance, polymorphism, encapsulation and abstraction implemented in the C++ programming language. Additionally, students will explore common data structures and containers, leveraging their understanding of OOP to design and implement efficient solutions. Through a series of real-time application projects, students will apply their knowledge to solve complex problems, gaining valuable experience in software development and engineering practices.

2. Course Objectives:

1. Instruct students in the foundational principles of C++.
2. Teach students the key concepts of Object-Oriented Programming (OOP) in C++.
3. Guide students in understanding and applying inheritance and polymorphism in C++.
4. Enable students to implement standard data structures and containers in C++.
5. Train students to develop concurrent applications using C++.

3. List of Experiments **30 periods**

1. Data types, variables, and constants:
   i. Compose a C++ program that demonstrates proficient utilization of various data types, variables, and constants to ensure efficient and purposeful data handling within the program(CO1)
2. Control Flow Statements:
   i. Develop a C++ program that simulates the modern warehouse automation system. It demonstrates its ability to monitor inventory levels, process incoming and outgoing shipments to effectively manage the execution flow, and generate real-time reports to optimize warehouse operations(CO1)

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3. Operators and Expressions:
   i. Create a comprehensive C++ program that allows users to perform various operations on their stock holdings. The program should provide functionality for buying and selling stocks, calculating portfolio performance metrics, and making investment decisions based on given criteria(CO1)
4. Functions, Pointers and Arrays:
   Implement a bank management system with C++ functions to handle transactions, account balances, and user authentication, thereby enhancing modularity, code reusability, and the overall efficiency of the program.(CO2)
5. Develop a C++ program that uses pointers to swap the values of two integers. Use type casting to access and manipulate the values through pointers.(CO2)
6. Develop a C++ program to implement a student grade tracker using arrays. Create an array to store the grades of multiple students and implement functions to calculate the average, find the highest and lowest grades, and display the overall performance.(CO2)
7. String Handling:
   i. Design a C++ program that generates personalized greeting strings based on user input. The greeting system requires creating a string consisting of a user's chosen greeting phrase replicated multiple times. If the chosen greeting is less than three characters, then the program should return n copies of the entire phrase.(C03)
   ii. Develop a secure access card generation system using string manipulation functions. Build a C++ program that generates a string consisting of four copies of the first two characters of the employee's name functions and produces a clear identification code.(CO3)
8. Design a C++ program for a dynamic blogging platform with an advanced content management system. Implement a feature that generates unique content identifiers for blog posts based on the author's name and the topic of the post.(CO3)
9. Object-Oriented Concepts:
   i. Develop a C++ program to create a library catalog system using classes and objects. Implement member functions to display book information and manage the catalog.
   ii. Develop a C++ program to simulate an online shopping cart using classes and objects. Define a class Implement member functions to add products to the cart, calculate the total cost, and display the items in the cart.
   iii. Develop a C++ program that showcases inheritance by creating a hierarchy of vehicles. Implement a base class Vehicle and derive two classes, Car and Motorcycle, from it. Each derived class should have specific attributes and extended functionalities.
   iv. Create a C++ program that demonstrates polymorphism by implementing a shape hierarchy and calculating the area of different shapes through a common interface(CO3)
10. Standard Template Library (STL):
   i. Develop a C++ program that uses dynamic memory allocation and a linked list structure to manage an Employee Database. Implement operations such as inserting a new employee, deleting an employee, and updating employee information. Ensure proper memory management to avoid memory leaks. (CO4)
11. Create a C++ program that uses dynamic memory allocation to implement a stack for managing Undo/Redo history. Implement operations such as pushing a state onto the stack (undo) and popping a state off the stack (redo). (CO4)

12. Develop a C++ program that uses dynamic memory allocation to implement a queue for managing a print queue. Implement operations such as enqueueing a print job and dequeuing a print job. (CO4)
13. Design a C++ program to manage product inventory using a vector of product objects. Sort products based on their prices using a sort operation and allow users to search for a product by name using binary search. (CO4)
14. Design a C++ program for managing course enrolments in an online learning platform using a tree data structure implemented with map operation. This program should allow users to add new courses, enrol students in courses, and efficiently search for available courses based on enrolment status and capacity using the lower bound algorithm. (CO5)
15. File handling:
    i. Design a C++ program that reads a given text file, counts the number of words present, and displays the result. (CO5)
16. **Project work:**
    Design and implement a practical application using C++ and OOP concepts.

Text Books:

1. C++20 - The Complete Guide by Nicolai M. Josuttis, 2022
2. The C++ Standard Library - A Tutorial and Reference, 2nd Edition by Nicolai M. Josuttis,2012

Reference Books:

1. Modern C++ Tutorial: C++11/14/17/20 On the Fly by Changkun Ou, 2023
2. Effective Modern C++: 42 Specific Ways to Improve Your Use of C++11 and C++14 by Scott Meyers, 2015

Web Resources:

1. https://www.tutorialspoint.com/cplusplus/index.htm
2. https://www.javatpoint.com/cpp-tutorial

MOOC/NPTEL /SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc21_cs02/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs42/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS452.1	Develop and demonstrate problem-solving for simple applications
U23CS452.2	Design and implement simple classes in C++ with well-defined attributes, methods, and appropriate access modifiers
U23CS452.3	Apply the concepts of inheritance and polymorphism by creating and managing class hierarchies and demonstrate runtime polymorphism
U23CS452.4	Implement appropriate Standard Template Library (STL) containers for various real-time applications
U23CS452.5	Implement real-time concurrent processing solutions by applying threads, mutexes and asynchronous programming

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U23EM752	Logical Thinking	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

This course aims to help students build strong skills in logical thinking, reasoning and problem-solving. They will learn to analyze and evaluate arguments, spot logical fallacies and create clear and convincing arguments. Through lectures and practical exercises, students will develop the critical thinking needed to tackle engineering problems methodically and precisely. They will also understand the importance of logical thinking in designing and implementing engineering solutions, making them more effective engineers.

2. Course Objectives:

1. Apply logical algorithms to tackle complex problem-solving scenarios.
2. Develop analytical skills for optimizing costs in logical operations.
3. Master time and resource management through logical approaches.
4. Strengthen quantitative reasoning for data-driven decision-making.
5. Enhance logical and visual reasoning to solve intricate problems effectively.

3. Syllabus: **30 Periods**

Unit-I: Fundamental Skills for Problem Solving **(6)**

Application of Problem-Solving in real life, Different algorithms in problem-solving: Brute force approach, Pattern finding method and Deep Learning Approach. Numbers System: Primes and factors, factors and factorials, divisibility rule, unit digit calculation and power cycle method, remainder concepts, HCF and LCM.

Unit-II: Critical Analysis of Cost Management **(6)**

Fundamentals of Finance: Percentages, Fluctuations in percentage, Profit and Loss, Pricing Logics, Retail Pricing Strategy; Interest calculation: Cash Flow and Taxes; Simple and Compound interest calculation, Puzzle related to interest changes and Case Studies.

Unit-III: Time and Work Management **(6)**

Fundamentals of Human Resources and Operations: Resources allocation, Time and Work, Puzzle involving backtracking, All possible routes, Pipes and Cisterns.

Unit-IV: Quantitative Reasoning and Data Interpretation **(6)**

Fundamentals of statistics: Mean, Median and Mode, Real-life life application of statistics, Application of Ratios and Proportions in business problems, Partnerships; Geometry: 2D, 3D Visualisation.

Unit-V: Logical and Visual Reasoning **(6)**

Paradigm shift and its application: Syllogism, Cube 3D visualisation problems, Blood Relation, Coding decoding: Basics and Advanced. Visual reasoning: Patterns, Paper folding, Case Studies and Puzzles.

References:

Reference Books:

1. Dr R S Aggarwal, Quantitative Aptitude, Revised Edition, S.Chand Publishing Company Ltd(s), 2022
2. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, 10th Edition, Tata McGraw-Hill Publishing Company Ltd, 2022

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Online References:

1. https://www.hackerearth.com/
2. https://www.geeksforgeeks.org/
3. https://www.indiabix.com/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23EM752.1	Apply logical algorithms and mathematical methods to solve real-world problems.
U23EM752.2	Analyze and evaluate cost management strategies in various contexts.
U23EM752.3	Apply principles of time management and work efficiency in practical situations.
U23EM752.4	Use quantitative methods and interpret data to make informed decisions.
U23EM752.5	Create solutions to complex logical and visual reasoning problems by applying advanced reasoning techniques

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U23MC902	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	L	T	P	J	C
		1	0	0	0	1

1. Course Description:

The intersection of Tamils and technology refers to the field of agricultural technology, focusing on the use of modern tools and techniques to enhance farming practices and increase agricultural productivity.

2. Course Objectives:

1. To increase agricultural productivity and profitability by implementing innovative solutions that optimize resource usage, minimize losses, and enhance crop yields.
2. To automate the irrigation systems to adjust water usage based on real-time data on soil moisture levels, weather forecasts, and crop water requirements.

3. Syllabus: **15 Periods**

Unit-I: Weaving and Ceramic Technology / நெசவு மற்றும் பானைத் தொழில்நுட்பம் **(3)**

Weaving Industry during Sangam Age – Ceramic Technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

Unit-II: Design and Construction Technology / வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் **(3)**

Designing and Structural construction of Houses & Designs in household materials during the Sangam Age - Building materials and Hero stones of Sangam Age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் &சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ- சாரோசெனிக் கட்டிடக் கலை

Unit-III: Manufacturing Technology / உற்பத்தித் தொழில் நுட்பம் **(3)**

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidence - Gem stone types described in Silappathikaram.

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும்

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தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

Unit-IV: Agriculture and Irrigation Technology / வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம் **(3)**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு- மீன்வளம் முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

Unit-V: Scientific Tamil and Tamil Computing /அறிவியல் தமிழ் மற்றும் கணித்தமிழ் **(3)**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

அறிவியல் தமிழின் வளர்ச்சி -கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம்- தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

Text Books:

1. தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே.பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும்கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

References:

Reference Books:

1. Journey of Civilization Indus to Vaigai - R. Balakrishnan, Published by: RMRL.
2. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).

4. Course Outcomes/ பாடநெறி முடிவுகள்:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome / பாடநெறி முடிவுகள்
U23MC902.1	Describe about the weaving industry in sangam age and ceramic technology. சங்க காலத்தில் நெசவுத் தொழில் மற்றும் பீங்கான் தொழில்நுட்பம் பற்றி விரிவாக அறிந்து கொள்ளுதல்.
U23MC902.2	Observe the design of houses, sculptures and construction of temples. வீடுகளின் வடிவமைப்பு, சிற்பங்கள் மற்றும் கோவில்களின் கட்டுமானத்தைப் பற்றி தெரிந்து கொள்ளுதல்.
U23MC902.3	Relate the various manufacturing materials and stone types in Silappathikaram. சிலப்பதிகாரத்தில் உள்ள பல்வேறு உற்பத்திப் பொருட்கள் மற்றும் கல் வகைகளைப் பற்றி புரிந்து கொள்ளுதல்.
U23MC902.4	Understand the significance of agriculture and irrigation technology in the ancient period. பண்டைய காலத்தில் விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நுட்பத்தின் முக்கியத்துவத்தை புரிந்து கொள்ளுதல்.
U23MC902.5	Explain the growth of scientific Tamil, Tamil computing and the digitization of Tamil books. அறிவியல் தமிழின் வளர்ச்சி, தமிழ்க் கணினி, தமிழ் நூல்களின் டிஜிட்டல் மயமாக்கல் ஆகியவற்றை விரிவாக தெரிந்து கொள்ளுதல்.

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SEMESTER III

U23MA204	Discrete Mathematics	L	T	P	J	C
		3	1	0	0	4

1. Course Description:

Discrete Mathematics is a foundational course that explores mathematical structures and concepts fundamental to computer science, information technology, AI, cryptography, and other fields. The course covers wide range of foundational concepts and techniques in discrete mathematics, emphasizing both theoretical understanding and practical problem-solving skills. This course helps to analyze and solve problems using discrete mathematical techniques such as propositional calculus, counting techniques, combinatorial principles, graphical representations and residual classes in number theory.

2. Course Objectives:

1. Familiarze the students to verify the correctness of an argument using symbolic logic and truth tables.
2. Train the students to solve problems using counting techniques.
3. Introduce various techniques in combinatorics and solving recurrence relations.
4. Impart the basic concepts of graphs and isomorphism between graphs.
5. Inculcate effectively the concepts and results of congruence.

3. Syllabus: **45 +15 = 60 Periods**

Unit-I: Logic and Proofs **(9+3)**

Propositional logic: Propositional equivalences, Normal forms; Predicates and quantifiers ; Rules of inference.

Unit-II: Counting Principles **(9+3)**

Well ordering principle; Basics of counting; Balls and Bins problems; The pigeonhole principle; Inclusion and exclusion principle.

Unit-III: Combinatorics **(9+3)**

Mathematical induction; Permutation and combination; Recurrence relations: Formation of Recurrence relation, Generating functions, Solving linear recurrence relation.

Unit-IV: Introduction to Graph Theory **(9+3)**

Graphs:Types of graphs, matrix representation of graphs, walk, path, circuit, graph isomorphism using adjacency matrix and circuits, Euler graph, Hamiltonian graph.

Unit-V: Introduction to Number Theory **(9+3)**

Linear diophantine equations; Congruence: Linear congruence, simultaneous linear congruences, Chinese remainder theorem (statement only), Wilson's theorem, Fermat's theorem, Euler's theorem.

List of Tutorials :

1. Construction of truth tables. (CO 1)
2. Solving recurrence equations. (CO 3)
3. Finding Permuations and combinations. (CO 3)
4. Construction of graphs and digraphs. (CO 4)
5. Matrix representstion of graphs. (CO 4)
6. Tracing Traversals, shortest path and cycles in a graph. (CO 4)
7. Solving Linear Diophantine equation. (CO 5)
8. Solving linear congruence and system of linear congruences. (CO 5)

Text Books:

1. Rosen. K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2017.
2. James Strayer, Elementary Number Theory, Waveland Press, 2002.

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References :

Reference Books:

1. Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education Asia, Delhi, 2013.
2. Koshy. T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.
3. Lipschutz. S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, 3rd Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, , 2010.
4. Tremblay. J.P. and Manohar. R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.

Journal References:

1. SIAM Journal on Discrete mathematics.
   https://www.siam.org/publications/siam-journals/siam-journal-on-discrete-mathematics/
2. Journal of Combinatorial Theory
   https://www.sciencedirect.com/journal/journal-of-combinatorial-theory-series-a
3. International journal of Number Theory.
   https://www.worldscientific.com/worldscinet/ijnt

Web Resources:

1. https://www.youtube.com/watch?v=xlUFkMKSB3Y
2. https://www.youtube.com/playlist?list=PLl-gb0E4MII0sGLCJeqDB3y63HZ6lM5LJ
3. https://www.youtube.com/playlist?list=PL5J6K3znOvOmzBUoxlk-W0N4j7L1Y9yfW
4. https://www.youtube.com/watch?v=LFKZLXVO-Dg
5. https://www.youtube.com/watch?v=1zFFnvyEgVU

MOOC/NPTEL /SWAYAM Courses:

1. https://nptel.ac.in/courses/106106094
2. https://nptel.ac.in/courses/106108051
3. https://archive.nptel.ac.in/courses/111/106/111106155/
4. https://archive.nptel.ac.in/courses/111/106/111106102/
5. https://archive.nptel.ac.in/courses/111/101/111101137/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23MA204.1	Apply the fundamental concepts of logics and inference theory in proving and testing the logics.
U23MA204.2	Operate counting problems by using the appropriate elementary counting techniques.
U23MA204.3	Utilize induction techniques and generating functions to solve mathematical statements.
U23MA204.4	Analyze the types of circuits in a graph, the existence of isomorphism and sketch the Euler and Hamiltonian paths and circuits in a graph.
U23MA204.5	Validate the congruence using the classical theorems and can perform the divisibility test using congruence.

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U23CS403	Design and Analysis of Algorithms	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

This course explores the fundamental principles of algorithmic design and analysis, equipping students with the essential tools to tackle complex computational problems efficiently. Through a comprehensive exploration of various algorithmic techniques, including Brute Force, Divide-and-Conquer, Dynamic Programming, Greedy Approach, Backtracking, and Branch and Bound, students will gain a profound understanding of how to formulate, analyze and optimize algorithms for diverse applications. Through hands-on exercises, projects and theoretical discussions, students will develop the skills necessary to design algorithms, assess their efficiency, and make informed decisions regarding algorithm selection for real-world problems.

2. Course Objectives:

1. To familiarize the student with analysis of algorithmic efficiency, including time and space complexity, to evaluate and compare algorithm performance.
2. To make students to work on efficient solutions to complex problems using brute force and divide-and-conquer techniques
3. To acquaint students with dynamic programming techniques to solve complex optimization problems.
4. To enable students to understand and apply the greedy approach to solve optimization problems.
5. To Equip students with the problem-solving strategies of backtracking and branch and bound problems.

3.Syllabus: **45 Periods**

Unit-I: Algorithm Analysis Techniques **(9)**

Notion of an algorithm , Importance & role of algorithms in computing , Important problem types; Analysis of algorithmic efficiency , Time and Space Complexity , Asymptotic notations and their properties ; Analysis framework: Mathematical analysis for recursive and non-recursive algorithms; String Algorithms: Naïve algorithm , Rabin Karp Algorithm , KMP Algorithm , Manachers algorithm

Unit-II: Brute Force and Divide-And-Conquer **(9)**

Brute force: Selection sort , String matching , Exhaustive search , Boyer Moore algorithm , Travelling salesman problem , Knapsack problem , Assignment problem , Huffman codes and data compression; Divide and Conquer: Binary search , Quick sort , Heap sort , Multiplication of large integer

Unit-III: Dynamic Programming **(9)**

Ugly numbers ; Coin changing problem ; Friends pairing problem ; Golomb sequence ; Warshall's algorithm , Floyd's algorithm , Multi stage graph , Optimal binary search trees , Fractional Knapsack Problem , K Knight's tour on chess board

Unit-IV: Greedy Approach **(9)**

Definition , Activity selection problem , Longest common subsequence , Sieve of Sundaram , Assign mice to holes; Huffman trees , Sparse matrix , Bloom filter

Unit-V: Backtracking and Branch and Bound **(9)**

Backtracking, Rat in maze , Permutation and Combination , N Queen problem , Hamiltonian circuit problem , Knight's tour problem , Subset sum problem , Graph Coloring ; Branch and Bound: Assignment problem , Knapsack problem , Travelling salesman problem

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Text Book:
1. Anany Levitin — Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2017
References:
Reference Books: 1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, —Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2022 2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2008 **Web Resources:** 1. https://www.javatpoint.com/daa-tutorial 2. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/ **MOOC/NPTEL /SWAYAM Courses:** 1. https://onlinecourses.nptel.ac.in/noc24_cs23/preview 2. https://www.udemy.com/course/design-and-analysis-of-algorithm

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS403.1	Understand the importance of designing strategies, time and space complexity
U23CS403.2	Apply brute force and divide and conquer strategies in solving problems
U23CS403.3	Apply dynamic programming in solving complex problems
U23CS403.4	Apply greedy algorithms in solving optimization problems
U23CS403.5	Compare the time and space complexities of different types of algorithms

U23CS404	Database Management Systems	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

This course offers a comprehensive exploration of Database Management Systems (DBMS) theory, focusing on essential concepts and principles underlying the design, implementation and optimization of databases. Students will explore into various topics, including an Introduction to Databases, Structured Query Language (SQL) & Procedural Language/SQL (PL/SQL), Transaction and Concurrency Control, Storage & Indexing, and NoSQL databases. The students will gain a deep understanding of database architectures, data modelling techniques, query languages, transaction management strategies, storage mechanisms, indexing methods and the role of NoSQL databases in modern data management.

2. Course Objectives:

1. To enable students to understand the fundamental concepts and principles of database management.
2. To teach students to master the database querying and programming using SQL and PL/SQL
3. To foster students to learn the principles and mechanisms of transaction processing and concurrency control

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4. To familiarize students to design and implement efficient database storage and indexing solutions
5. To acquaint students to effectively use NoSQL databases to build scalable, high-performance applications

3.Syllabus: **45 periods**

Unit-I: Introduction to Databases **(9)**

Purpose of Database , Types and examples of Databases (RDBMS, NOSQL, In-memory Databases & Distributed SQL databases) , Relational Database System Architecture ; Views of Data , Schema architecture , Data Independence , Schema and instance ; Data Models , Benefits and Phases of Data Model ; ER Diagram: Symbols , Components , Relationships , Weak entities , Attributes , Cardinality , Extended ER Diagram , Examples ; Relational Data Model ; Keys ; Relational Algebra; Normalization: 1NF, 2NF, 3NF, BCNF,4NF,5NF;

Case Study: ER Diagram on Online Streaming, Movie Ticket Recommendation, Bike Tracking

Unit-II: SQL & PL/SQL **(9)**

SQL Fundamentals : DDL Commands , Create, Drop, Alter, Truncate, Rename ; Keys : Primary Key, Candidate Key, Super Key, Foreign Key ;DML Commands , DQL Commands : Select, Insert, Update, Delete, Any, All, In, Exists, Non-Exists, Union, Intersection ; Advanced SQL Features , Aggregate Functions : SUM, COUNT, AVG, MIN, MAX, EXPLAIN, COALESCE ; Clauses , Order By , Group By, Having, CASE, LIMIT,WITH Clause, Date Functions, String Functions ; Subqueries , Nested, Correlated, Joins : Inner, Outer, and Equi-Joins ; Order of Execution, Embedded SQL , Dynamic SQL ; Creation and Dropping of Views, Types of Views , Creation and Execution of Stored Procedures , Cursors : Opening, Fetching, and Closing ; Triggers : Creation, Insertion, Deletion, and Updating Database ; Exception Handling ; MySQL JDBC Connectivity

Case Study: Online Streaming, Movie Ticket Recommendation, Bike Tracking, Import/Export Random records from CSV file to MYSQL

Unit-III: Transaction and Concurrency Control **(9)**

Transaction processing: ACID Properties , Failure and Recovery , Schedules , Serializability , Concurrency Control , Lock-based protocol , Isolation levels ; SQL Facilities for concurrency and recovery , Database Integrity, Security and Authorization

Case Study: ACID Properties in Online Streaming Database

Unit-IV: Storage & Indexing **(9)**

Overview of Storage Techniques : File organization , RAID ; Indexing : Types of ordered indices , B & B+ tree ; Hashing : Static & Dynamic Hashing , Query Processing & Optimization , SQL Performance Tuning

Case Study: Indexing in Online Streaming Database to optimize the retrieval of data

Unit-V: NOSQL **(9)**

Need for NO SQL , Characteristics of NOSQL , Key-value database , Columnar Databases , Apache Cassandra , Click House , Document Databases , MongoDB : CRUD operations with MongoDB , MongoDB JDBC Connectivity , MongoDB Testing , Graph Databases , Metabase

Case study: Conversion of Online Streaming Database (RDBMS) to MongoDB

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, — ”Database System Concepts”, Seventh Edition, Tata McGraw Hill, 2019
2. RamezElmasri, Shamkant B. Navathe, —”Fundamentals of Database Systems”, Sixth Edition, Pearson Education, 2014

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References:

References Books:

1. C.J.Date, A.Kannan, S.Swamynathan, —"An Introduction to Database Systems", Eighth Edition, Pearson Education, 2013
2. KrisitnaChodorow, "MongoDB – The Definitive Guide", O' Reilly, 2013

Web References:

1. https://www.youtube.com/playlist?list=PLsjUcU8CQXGFFAhJI6qTA8owv3z9jBbpd
2. https://www.youtube.com/watch?v=c5HAwKX-suM
3. https://youtu.be/FNYdBLwZ6cE
4. https://youtu.be/qEhNHOEa5sE

MOOC/NPTEL /SWAYAM Courses:

1. https://onlinecourses.NPTEL.ac.in/noc23_cs41/preview
2. https://codewithmosh.com/p/complete-sql-mastery
3. https://www.udemy.com/course/nosql-databases-for-beginners/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS404.1	Use data models and depict a database system
U23CS404.2	Design relations for various business requirements
U23CS404.3	Understand the properties of the database and recovery process
U23CS404.4	Understand the optimization techniques in database storage
U23CS404.5	Design non-structured database systems in application development

U23EC382	Digital Principles and Computer Organization	L	T	P	J	C
		3	0	2	0	4

1. Course Description:

This course provides a thorough exploration of the foundational concepts in digital systems, including binary arithmetic, logic gates, and sequential circuits. It emphasizes the organization of computer systems, with in-depth coverage of CPU architecture, memory systems, and input/output mechanisms. Students will gain valuable insights into how these critical components work together to create modern computing systems. By the end of the course, participants will have a solid understanding of digital principles and computer organization, preparing them to navigate and contribute to the rapidly evolving field of computing.

2. Course Objectives:

1. To facilitate understanding of logic gates and minimization techniques.
2. To guide design of simple combinational logic circuits.
3. To instruct on operation of sequential logic circuits.
4. To demonstrate the basic architecture of computer organization.
5. To explain the principles of parallel processing and memory hierarchy.

3.Syllabus: **45 + 30 = 75 Periods**

Unit-I: Logic Gates and Minimization Techniques **(9)**

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Basic Theorems and properties of Boolean algebra – canonical form and standard forms – digital logic gates – Minimization Techniques: K-Map (up to 4 variables) – Don't care condition - NAND & NOR Implementation.

Unit-II: Combinational Logic Circuits **(9)**

Combinatorial Logic Circuits: Design Procedure – Half adder and Full adder – Half Subtractor and Full Subtractor – Magnitude comparator – Encoder and Decoder - Multiplexer and Demultiplexer – code converter (binary to gray, BCD to excess-3 and vice versa)

Unit-III: Sequential Logic Circuits **(9)**

Sequential Circuits: Flip-flops-Triggering of Flip-flops- Registers – Shift Registers – Ripple Counters -Synchronous counters (up and down counter) – Random Access Memory (RAM)

Unit-IV: Basic Computer Organization **(9)**

Data Representation: Fixed and Floating Point – Micro operations: Arithmetic, Logic, shift – Arithmetic Logic Shift Unit – Instruction Codes – Computer registers – Computer Instructions – Timing and control – Instruction Cycle – Design of Basic computer

Unit-V: Performance Enhancement Techniques **(9)**

Parallel processing - Pipelining – Arithmetic and Instruction pipeline – RISC pipeline - Memory hierarchy Main memory - Cache memory – Characteristics and Multiprocessors – Interconnection Structures.

List of Experiments **(30 Periods)**

1. Verification of Boolean theorems using logic gates. (CO 1)
2. Implementation of half adder and full adder using logic gates. (CO 2)
3. Implementation of Multiplexer and De-multiplexer using logic gates. (CO 2)
4. Verification of JK and D Flip-flops. (CO 3)
5. Implementation of SISO and PIPO 4-bit shift register using Flip- flops. (CO 3)
6. Construction and verification of 4 bit ripple counter and interpret the concepts of logic shift operation. (CO 4)
7. Design and implementation of 2 bit ALU using various combinational circuits. (CO 5)

Text Books:

1. M. Morris Mano, Michael D Ciletti, "Digital Design", Pearson, 6/e, 2018 (Module I, II, III)
2. Computer System Architecture, M. Morris Mano, Pearson Education, 3/e, 2017 (Module IV & V)

References:

Reference Books:

1. Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications", MGH, 8/e, 2014
2. Thomas L. Floyd, "Digital Fundamentals", Pearson, 11/e, 2017
3. John L. Hennessy, David A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann Press, 5/e, 2012
4. William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson, 10/e, 2016

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Web Resources:

1. https://www.geeksforgeeks.org/architecture-of-8085-microprocessor/
2. https://www.elprocus.com/embedded-system-programming-using-keil-c-language/
3. https://www.circuitbasics.com/introduction-to-the-raspberry-pi/
4. https://www.circuitbasics.com/getting-started-with-the-arduino/
5. https://projectacrn.github.io/1.6/tutorials/up2.html

MOOC / NPTEL / SWAYAM Course:

1. https://onlinecourses.nptel.ac.in/noc20_ee42/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23EC382.1	Understand the working of logic gates and Apply minimization techniques
U23EC382.2	Design of combinational logic circuits
U23EC382.3	Comprehend the operation of sequential logic circuits
U23EC382.4	Understand the basic computer organization
U23EC382.5	Understand the various performance enhancement techniques

U23AD491	Data Science	L	T	P	J	C
		2	0	2	2	4

1. Course Description:

The course aims to provide students with a comprehensive understanding of data science, covering key concepts, methodologies, and tools essential for data analysis, interpretation, and decision-making. Students will learn to collect, preprocess, and analyze data from various sources using statistical techniques and machine learning algorithms. Students will gain practical experience in applying data science methods to real-world problems. By the end of the course, students will be equipped with the knowledge and proficiency needed to extract valuable insights from data, make informed decisions, and contribute effectively to the rapidly evolving field of data science.

2. Course Objectives:

1. Gain a foundational understanding of data science concepts and methods.
2. Develop the ability to collect, clean, and manage data.
3. Learn how to analyse data using statistical and machine learning techniques.
4. Develop the ability to solve real-world problems using data science.
5. Develop an understanding of the ethical implications of data science

3. Syllabus: **30+30+30= 90 Periods**

Unit-I: INTRODUCTION TO DATA SCIENCE AND DATA ACQUISITION (6)

Data science: definition, scope, importance of data-driven decision making, interdisciplinary nature of data science, stages of data science life cycle; overview of data science tools and techniques, applications of data science; Data acquisition: Sources of data, data collection and API, web scraping: extracting data from websites, accessing different sources of data.

Unit-II: STATISTICAL CONCEPTS FOR DATA SCIENCE (6)

Role of Statistics in Data Science; Population vs. Sample; Descriptive vs. Inferential statistics; Probability distributions: Poisson, Normal, Binomial, Uniform; Bayes' theorem and conditional probability; Descriptive statistics: Measures of central tendency: Mean, median, mode; Measures of dispersion: Variance, standard deviation; Inferential statistics: Hypothesis testing: Null and alternative hypotheses, p-values; Confidence intervals, ANOVA, Chi-square test, T-test; Correlation and Covariance.

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Unit-III: DATA VISUALIZATION **(6)**

Tableau: Introduction, Overview of Tableau interface and workspace; Features and advantages, connecting to data sources, importing data from local files and cloud storage services, creating basic visualizations in Tableau: Bar charts, line charts, scatter plots, pie charts, histograms, heatmaps, advanced visualization techniques in Tableau:Treemaps, bubble charts, box plots, dual-axis charts, combination charts, adding filters and parameters, building interactive dashboards in Tableau.

Power BI: Overview, connecting to data Sources in Power BI, Importing data from local files, databases, and web sources; creating basic visualizations in Power BI: Bar charts, line charts, scatter plots, pie charts, histograms, heatmaps; advanced visualization techniques in Power BI: Treemaps, bubble charts, box plots, dual-axis charts, combination charts, building interactive dashboards in Power BI.

Unit-IV: DATA EXPLORATION AND FEATURE ENGINEERING **(6)**

Data analytics: descriptive analysis, diagnostic analytics, predictive analytics, predictive analytics; Data pre-processing: handling missing values – imputation techniques, dealing with outliers; Exploratory Data Analysis(EDA); Feature Engineering: One-hot encoding, label encoding, creating new features, dimensionality reduction techniques.

Unit-V: TOOLS FOR DATA SCIENCE **(6)**

Microsoft Excel for data analysis: Introduction to Excel for basic data manipulation and analysis, data cleaning and formatting techniques in Excel, creating charts and graphs, pivot tables and pivot charts for summarizing and analyzing data, advanced Excel features for statistical analysis; Python packages for data science: NumPy for statistical analysis, data manipulation with Pandas data frames, data visualization using Matplotlib and Seaborn library.

LIST OF EXPERIMENTS: **30 Periods**

1. Web Scrapping
   Use Case: Perform Web-Scrapping, create DataFrame by collecting the data from the suitable resource. (CO 1)
2. Exploratory Data Analysis: Perform Data Preprocessing & Data Wrangling on Netflix International Dataset. (CO 2, CO 4)
3. Exploratory Data Analysis: Perform EDA on Netflix International Dataset. (CO 2, CO 4)
4. Fraud Detection in Financial Transactions
   Use Case: A banking institution aims to detect fraudulent transactions by analyzing historical transaction data.
   Experiment: Explore the dataset to identify patterns and anomalies indicative of fraudulent behavior. Develop new features such as transaction frequency, transaction amount, and geographical location. Apply anomaly detection techniques to flag suspicious transactions for further investigation. (CO 4)
5. Predictive Maintenance for Industrial Equipment
   Use Case: A manufacturing plant wants to implement predictive maintenance strategies to minimize downtime and optimize equipment performance.
   Experiment: Explore sensor data collected from industrial equipment to identify patterns associated with equipment failures. Engineer features such as equipment usage, temperature, and vibration levels. Train machine learning models to predict equipment failures before they occur based on historical sensor data. (CO 2, CO4)
6. Market Segmentation Analysis- Tableau
   Use Case: A beverage company is planning to launch a new health drink targeted towards health-conscious consumers. However, they recognize that the health-conscious market is diverse, with varying preferences and needs. To ensure the success of their product, they decide to conduct a market segmentation analysis. (CO 3)
7. Covid-19 Trends- Power BI
   Use Case: During the COVID-19 pandemic, public health authorities and policymakers need accurate and timely information to respond effectively to the evolving situation. Market segmentation analysis can be a valuable tool to understand how different population segments

are affected by the virus, which can inform targeted interventions and resource allocation. (CO 3)

8. Exploring COVID-19 Data Trends

   Use Case: Health authorities want to visualize and analyze trends in COVID-19 cases to inform public health policies.

   Experiment: Collect COVID-19 data from reliable sources such as government health departments. Use data visualization tools to create interactive dashboards displaying trends in case counts, testing rates, and vaccination coverage. Analyze the data to identify hotspots and patterns over time. (CO 4)

9. Visualizing Stock Market Volatility

   Use Case: Financial analysts want to visualize and analyze stock market volatility to make informed investment decisions.

   Experiment: Gather historical stock market data from financial databases. Use data visualization techniques to create candlestick charts and volatility plots showing price fluctuations and trading volumes. Apply technical analysis indicators such as moving averages and Bollinger Bands to identify potential trading opportunities. (CO 4)

10. Sales Performance Analysis

    Use Case: Analyze sales data to identify top-performing products and regions for strategic decision-making.

    Experiment: Analyze sales data using Microsoft Excel to uncover insights into sales performance and trends. Utilize Excel's data manipulation, visualization, and analysis tools to examine total sales revenue, product performance, regional sales distribution, and sales trends over time. (CO 5)

Projects: **30 Periods**

Projects in the area of data science for real time applications. (CO 1 to CO 5)

Text Books:

1. Avrim Blum, John Hop croft, and RavindranKannan," Foundations of Data Science", Springer-2018
2. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", O'Reilly, 2013.
3. CathyO'Neil, Rachel Schutt, "Doing Data Science, Straight Talk from The Frontline", O'Reilly, 2013.
4. Chandraish Sinha, "Tableau 10 for Beginners: Step by Step Guide to Developing Visualizations in Tableau 10", Createspace Independent Pub, 2017.

References:

Reference Books:

1. Dean J, "Big Data, Data Mining and Machine learning", Wileypublications, 2014.
2. Provost F and Fawcett T, "Data Science for Business",O'Reilly Media Inc, 2013.
3. https://onlinecourses.nptel.ac.in/noc21_cs69/
4. https://pll.harvard.edu/course/data-science-visualization

Journals:

1. https://jds-online.org/journal/JDS
2. https://link.springer.com/journal/41060
3. https://epjdatascience.springeropen.com/

Web Resources:

1. https://www.youtube.com/watch?v=-ETQ97mXXF0
2. https://www.youtube.com/watch?v=dcXqhMqhZUo&t=2s

MOOC/NPTEL/SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs32/preview

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23AD491.1	Apply the fundamentals of data science for the real-world applications.
U23AD491.2	Analyze the distribution of data using various statistical techniques.
U23AD491.3	Design interactive dashboards using suitable data science tools to reveal the insights of data.
U23AD491.4	Apply the various data collection and exploration techniques to analyze the data.
U23AD491.5	Analyze datasets using Python packages and Microsoft Excel to derive actionable predictions.

U23CS491	Java Programming	L	T	P	J	C
		2	0	2	2	4

1. Course Description:

This course provides a comprehensive understanding of Java programming language and its application development capabilities. Through theoretical discussions and hands-on lab exercises, students will learn the foundational concepts of Java, object-oriented programming principles, advanced features of Java 8, exception handling, multithreading, JavaFX for GUI development, and JDBC for database connectivity. By the end of the course, students will have the knowledge and skills to develop robust Java applications and graphical user interfaces.

2. Course Objectives:

1. To establish a foundation in Java programming concepts.
2. To empower students to master object-oriented mechanisms in java programming
3. To teach students to expertly handle strings, collections, and Java 8 features
4. To familiarize the students to build reliable and concurrent Java programs using exception handling and multithreading
5. To acquaint students to build dynamic, data-driven desktop applications using JavaFX and JDBC

3. Syllabus: **30+30+30=90 Periods**

Unit-I: Foundations of Java **(6)**

Overview of OOP, Object oriented programming paradigms, Features of Object Oriented Programming , Java Buzzwords ; Overview of Java : JVM , JDK , Programming Structures in Java, Classes & its types in Java , Data Types, Variables, Operators , Keywords , Control Statements, Wrapper Classes , Constructors , Methods, Access specifiers ; Arrays & its types, java.util.Arrays, Java Doc comments , I/O classes

Unit-II: Object Oriented Mechanisms **(6)**

Association , Aggregation, Composition , Polymorphism, Overloading Vs Overriding, Static and Dynamic Binding, Inheritance: Basics, Types of Inheritance, Super, static & final keywords with inheritance and polymorphism, Abstraction, Abstract Classes and Interfaces, Encapsulation, Packages, Access modifiers

Unit-III: Strings, Collections & Java 8 Features **(6)**

Strings, creation, declaration of a string, storage structure of a string and its methods, StringBuilder, String Buffer, regex, Collection ; Interface, Generics, List, Set, Map interfaces and classes, Comparable , Comparator , Java lambda expressions, Date & time Object in java 1.8 and its functions , Streams

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Unit-IV: Exception Handling and Multithreading **(6)**

Exception handling , Hierarchy, Types of exception, Mechanisms , try , catch , throw , throws and finally , Exception Propagation - Exception in Inheritance - Introduction to Multiprocessing - threads vs process – threads - Creation of thread - Thread states - Thread Lifecycle and its methods, Executor Framework, Concurrency API, Synchronization Blocks

Unit-V: Javafx & Jdbc **(6)**

JAVAFX Events and Controls: Event Basics , Handling Key and Mouse Events ; Controls: Checkbox, ToggleButton , RadioButtons , ListView , ComboBox , ChoiceBox , Text Controls , ScrollPane , Layouts , FlowPane , HBox and VBox , BorderPane , StackPane , GridPane; Menus: Basics , Menu bars , MenuItem , JDBC , drivers, Steps to create a JDBC application , DB Connection Pool

List of Experiments: **30 Periods**

1. Implement class, objects, data types, operators, control statements, wrapper classes and scanner classes using java (CO 1)
2. Implement command line arguments with i/o packages using java (CO 1)
3. Implement sequential search, binary search and quadratic sorting algorithms using java (CO 1)
4. Implement encapsulation, abstraction, polymorphism and inheritance using java (CO 2)
5. Implement interface by accessing super class constructors and methods using java (CO 2)
6. Implement string, string functions, string builder, string buffer and regex using java (CO 3)
7. Implement lambda expression & for each() method using java (CO 3)
8. Implement generics-wildcard expression using java (CO 3)
9. Implement stack and queue data structures using java (CO 3)
10. Implement list, map, set, date and time using java (CO 3)
11. Implement exception handling by creating user-defined exceptions using java (CO 4)
12. Implement multithreading and inter-thread communication using java (CO 4)
13. Develop applications using javafx controls, layouts and menus (CO5)

Project: **30 Periods**

Develop a Java application for any real-world problem

Text Books:

1. Herbert Schildt., “Java: The Complete Reference”, 12th Edition, McGraw Hill Education, New Delhi, 2019
2. Cay S.Horstmann., “Core Java Fundamentals”, Volume 1, 11th Edition, Prentice Hall, 2018

References:

Reference Books:

1. Deitel P and Deitel H, "Java: How to Program", 11th Edition, Prentice Hall, 2018.
2. James Gosling, Bill Joy, Guy Steele, Gilad Bracha, Alex Buckley and Daniel Smith, "The Java Language Specification – Java SE", 13th Edition, Oracle America Inc., USA, 2019.
3. Matt Weisfeld, "The Object-Oriented Thought Process", 5th Edition, Addison-Wesley Professional, US, 2019.
4. Daniel Liang L, "Introduction to Java Programming", 10th Edition, Pearson Education, New Delhi, 2015.

Web Resources:

1. https://www.javatpoint.com/java-tutorial
2. https://docs.oracle.com/javase/tutorial/
3. https://www.geeksforgeeks.org/java/

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MOOC/NPTEL /SWAYAM Courses:

1. https://www.coursera.org/specializations/object-oriented-programming
2. https://intellipaat.com/academy/course/java-training/
3. https://www.udemy.com/course/java-tutorial/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS491.1	Understand the core concepts of Java programming
U23CS491.2	Explain the principles of object-oriented programming (OOP) and apply them to develop Java applications.
U23CS491.3	Analyze and apply the concepts of strings, collections, and Java 8 features to solve programming problems
U23CS491.4	Develop Java applications with effective exception handling mechanisms and implement multithreading concepts
U23CS491.5	Design and develop windows-based applications using JavaFX, incorporating various GUI components and event handling mechanisms.

U23CS453	Design and Analysis of Algorithms Laboratory	L	T	P	J	C
		0	0	4	0	2

1. Course Description:

In this practical course students will immerse themselves in the application of foundational algorithm techniques to real-world problems. Through hands-on exercises, coding assignments and project work, students will gain practical experience in Algorithm Analysis Techniques, including Brute Force, Divide-and-Conquer, Dynamic Programming, Greedy Approach, Backtracking and Branch and Bound. By implementing these algorithms in various programming languages, students will develop a deep understanding of their operation, efficiency and applicability across different problem domains. Through iterative refinement and experimentation, students will hone their algorithmic design skills, learning to optimize solutions for performance and scalability.

2. Course Objectives:

1. Instruct students on analyzing algorithmic efficiency, including time and space complexity, to evaluate and compare algorithm performance.
2. Guide students in developing efficient solutions to complex problems using brute force and divide-and-conquer techniques.
3. Teach students dynamic programming techniques for solving complex optimization problems.
4. Enable students to understand and apply the greedy approach for solving optimization problems.
5. Equip students with problem-solving strategies using backtracking and branch-and-bound techniques.

3. List of Experiments: **60 Periods**

1. Implementation of string algorithms (CO1)
2. Demonstration of applications of string algorithms (Naïve algorithm, Rabin Karp Algorithm,

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KMP Algorithm and Manachers algorithm) (CO1)

3. Implementation of brute force and divide-and-conquer techniques (CO1)
4. Demonstration of applications of brute force and divide and conquer techniques (Boyer Moore algorithm, Travelling salesman problem, Knapsack problem, Assignment problem, Jump game, Maximum subarray, Merge Intervals, Tiling problem, Karatsuba algorithm) (CO2)
5. Implementation of dynamic programming (CO3)
6. Demonstration of applications of dynamic programming (Warshall's algorithm, Floyd's algorithm, Knapsack Problem, Longest Common Subsequence, Levenshtein distance (Edit distance) problem, Longest palindrome, Longest common substring, Longest happy string, Palindrome partitioning, Minimum coin change, Equal subset sum partition, Wildcard matching, longest repeated subsequence)(CO4)
7. Implementation of Greedy approach(CO4)
8. Demonstration of applications of Greedy approach (Activity Selection Problem, Graph Colouring Problem, Huffman coding compression algorithm, shortest superstring problem, Flip the world, Dials algorithm, Minimum spanning tree, Sieve of sundaram, Remove invalid parenthesis, Maximum ribbon cut) (CO4)
9. Implementation of backtracking and branch & bound(C05)
10. Demonstration of applications of backtracking and branch & bound (Queen problem, Hamiltonian circuit problem, Knight's tour problem, Subset sum problem, Sudoku Solver, Letter combinations of a phone number, Combinatorial optimization problems, Zigzag conversion, Valid Sudoku, People holding hands, Reverse pairs) (CO3 , CO4, CO5)

Mini project: Create a simple gaming application

References:

Reference Book:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2008

Web Resources:

1. https://www.javatpoint.com/daa-tutorial
2. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/
3. https://www.udemy.com/course/design-and-analysis-of-algorithm

MOOC/NPTEL /SWAYAM Course:

1. https://onlinecourses.nptel.ac.in/noc24_cs23/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS453.1	Implement various algorithm design strategies in a programming environment and analyze their time and space complexities
U23CS453.2	ly brute force, divide and conquer strategies for sorting and searching tasks
U23CS453.3	Implement dynamic programming solutions for complex optimization and pathfinding problems
U23CS453.4	Apply greedy algorithms to solve optimization problems
U23CS453.5	Analyze the time and space complexities of different algorithms

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U23CS454	Database Management Systems Laboratory	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

This practical course offers hands-on experience in essential database concepts and technologies. Students will explore into Introduction to Databases, mastering the fundamentals of data modelling and relational database design. They will then explore Structured Query Language (SQL) and Procedural Language/SQL (PL/SQL), acquiring skills in querying and manipulating data. Through practical exercises, students will learn Transaction and Concurrency Control techniques, ensuring data integrity and consistency in multi-user environments. Additionally, they will gain proficiency in Storage & Indexing, optimizing database performance through efficient data storage and retrieval strategies. Finally, students will explore NoSQL databases, understanding their unique characteristics and applications in modern data management scenarios

2. Course Objectives:

1. To enable students to understand the fundamental concepts and principles of database management.
2. To teach students to master the database querying and programming using SQL and PL/SQL
3. To foster students to learn the principles and mechanisms of transaction processing and concurrency control
4. To familiarize students to design and implement efficient database storage and indexing solutions
5. To acquaint students to effectively use NoSQL databases to build scalable, high-performance applications

3. List of Laboratory Experiments: **30 Periods**

1 ER Diagrams (CO1)

Create an Entity Relationship model for the above applications

2 SQL Queries (CO2)

Develop the SQL Queries using the following commands for the database

a. DDL commands - Create, alter (Add, Modify, Rename), Truncate, Drop commands

b. DML commands - Insert, Update, and Delete commands

c. DQL commands - Select and its basic operations

d. DCL commands - Commit, Rollback, and Savepoint operations

e. TCL commands - Grant and Revoke operations for the different users

3 Implementation of Key constraints(CO2)

a. Build the Integrity Constraints - Unique, NOT NULL, Auto Increment, Primary Key, Foreign Key, Check, Default constraints for the given databases

4 Advanced SQL Queries(CO2)

Implementation of Aggregate Functions

a. Find the total count of all the records in the table

b. Find the average value of a specific column in the table

c. Find the maximum/min/sum value of a specific column in the table

d. Find the count of all distinct values in a specific column in the table

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5 Implementation of Group By Clause(CO2)

a. Find the average/max/min/sum of all values of a specific column for each group records in the table

b. Find the count/average/max/min of all records in the table grouped by multiple columns

6 Implementation of OrderBy Clause(CO2)

a. Sort the list of all records in the table by multiple columns/specific columns in ascending or descending order

b. Find the top/ bottom 10 records in the table sorted by a specific column/multiple columns

c. Find the list of all records in the table sorted by a specific column/multiple columns and limited to a certain range

7 Implementation of String Functions(CO2)

a. Find the length of characters in a specific string

b. Find the leftmost/rightmost portion of a specific string up to a certain character or length

c. Find the specific portion of a string extracted using a regular expression pattern

d. Find the specific string with all occurrences of a certain character or pattern replaced with another character or string

e. Find the specific string converted to uppercase or lowercase

f. Find the specific string with leading or trailing whitespace characters removed

g. Find the specific string with a certain character or substring removed or replaced

h. Find the specific string with a certain character or substring added at a certain position

i. Find the specific string with all occurrences of a certain substring concatenated with another substring

8 Implementation of Date function(CO2)

a. Find the current date and time in MySQL

b. Find the day of the week for a specific date in MySQL

c. Find the month/year for a specific date in MySQL

d. Find the difference between two specific dates in MySQL

e. Find the date in MySQL after adding/subtracting a specific number of days to a specific date.

f. Find the number of days/average time between two specific dates in MySQL

g. Find the earliest or latest date in a specific column of the table in MySQL

9 Implementation of Nested queries(CO3)

a. Find the maximum/min/count/sum/average/distinct count value of a specific column in the table for a specific subset of records selected using a nested query

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b. Find the average/max/sum/count/min value of a specific column in the table where the value of another column is equal to a specific value selected using a nested query

c. Find the maximum value of a specific column in the table for a specific subset of records selected using a nested query within another nested query

10 Implementation of Joins(CO3)

a. Find the result of an inner/left/right/full outer/cross joins between two/multiple tables on a specific column in MySQL

11 Construction of Index(CO3)

a. Create an index for the database and show the comparative analysis of Query execution time with and without using an index for the given scenario

12 Implementation of views(CO3)

a. Perform the DDL, DML, and DQL operations on the views and check the consistency of the relations

b. Create different types of views and their categories of the REFRESH command.

c. Implement the materialized views with Aggregate and Join queries

13 PLSQL(CO4)

Develop a program in PLSQL using Before/After trigger, row, and statement trigger and instead of trigger

a. Develop a program in PLSQL using Before/After trigger, row, and statement trigger and instead of trigger.

b. Create a trigger and check for the before/after insertion, update, and deletion operations in the table.

14 NOSQL(CO5)

Implementation of MongoDB application and run through CRUD operations

a. Command to create a collection and a document in MongoDB

b. Command to insert/update/delete a document in a MongoDB collection

c. Command to query a MongoDB collection to retrieve documents that meet certain criteria

d. Command to use aggregation pipelines to perform more complex queries in MongoDB

e. Command to create an index in MongoDB to improve query performance

15 Create tables and execute the queries using Click House(CO5)

a. Command to create a table, view, and functions

b. Command to insert the data in a table from compressed files, Infiles, and multiple files

c. Command to query the data using the SELECT, WHERE, JOIN, GROUPBY, HAVING clauses

d. Command to query the data using the Regular, Aggregate, and Table functions

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Design a project for the following application using JDBC Connectivity

- Online Food Ordering System
- Online Movie Ticket Booking System
- Online Parking System
- Online Hotel Room Booking System

References:

References Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, —"Database System Concepts", Sixth Edition, Tata McGraw Hill, 2013
2. Ramez Elmasri, Shamkant B. Navathe, —"Fundamentals of Database Systems", Sixth Edition,Pearson Education, 2014
3. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence – "Sadalage, P. & Fowler, Pearson Education, 2013
4. C.J.Date, A.Kannan, S.Swamynathan, —"An Introduction to Database Systems", Eighth Edition, Pearson Education, 2013
5. KrisitnaChodorow, "MongoDB – The Definitive Guide", O' Reilly, 2013

Web References:

1. https://www.youtube.com/playlist?list=PLsjUcU8CQXGFFAhJI6qTA8owv3z9jBbpd
2. https://www.youtube.com/watch?v=c5HAwKX-suM
3. https://youtu.be/FNYdBLwZ6cE
4. https://youtu.be/qEhNHOEa5sE

MOOC/NPTEL /SWAYAM Courses:

1. https://onlinecourses.NPTEL.ac.in/noc23_cs41/preview
2. https://codewithmosh.com/p/complete-sql-mastery
3. https://www.udemy.com/course/nosql-databases-for-beginners/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS454.1	Demonstrate the ability to identify, define, and analyze complex problems using ER diagram
U23CS454.2	Write queries for different business requirements
U23CS454.3	Implement Joins, Nested queries and built in functions for different database applications
U23CS454.4	Design and implement reusable PL/SQL procedures, functions and triggers that encapsulate business logic and perform complex data manipulations efficiently
U23CS454.5	Analyze data storage design and implement the operations of a NoSQL database

SEMESTER IV

U23MA209	Probability and Statistics	L	T	P	J	C
		3	1	0	0	4

1. Course Description:

This course provides a foundational understanding of probability theory and statistical methods, essential for making informed decisions in diverse fields such as science, engineering, business and social sciences. The curriculum encompasses both theoretical principles and practical applications, enabling students to analyze data, draw meaningful inferences, and make informed decisions in uncertain situations.

2. Course Objectives:

1. Familiarize the students on outcomes of random occurrences.
2. Enhance them in various distributions and its applications.
3. Impart the knowledge of correlation and regression and interpret the linear regression equation.
4. Inculcate inference about the population on the basis of a random sample.
5. Train them to approximate the value of a population parameter on the basis of sample statistics.

3. Syllabus: **45 +15 = 60 Periods**

Unit-I: Random Variables **(9+3)**

Probability axioms; Conditional probability; Baye's theorem statement only; Discrete and continuous random variables; Moments, moment generating functions.

Unit-II: Standard Probability Distributions **(9+3)**

Discrete distributions: Binomial distribution, poisson distribution; Continuous distributions: Uniform distribution, exponential distribution, normal distribution.

Unit-III: Two Dimensional Random Variables **(9+3)**

Joint probability distributions; marginal and conditional distributions; covariance; correlation and regression for discrete case.

Unit-IV: Testing of Hypothesis **(9+3)**

Introduction, Critical region and level of significance; Types of Errors; Large sample tests: Z-test for single mean and difference of means; Small sample tests: Student's t-test for testing significance of single mean and difference of means; F-test for comparison of variances; Chi-square test: Test of goodness of fit, Test of independence of attributes.

Unit-V: Design of Experiments **(9+3)**

Analysis of variance, One way classification: Completely randomized design; Two way classification: Randomized block design; Three way classification: Latin square design.

List of Tutorials :

1. Using statistical software R data numerically to perform data analysis. (CO 1)
2. Introduction: Understanding Data types; importing/exporting data. (CO 1)
3. Generation of Poisson and uniform random variables. (CO 1)
4. Generation of Gaussian and exponential random variables. (CO 2)
5. Computation of the probability distributions. (CO 2)
6. Fitting of Normal distribution. (CO 2)
7. Estimation of mean and variance. (CO 2)
8. Implementation of various statistical measures like mean, median, mode. (CO 2)
9. Applying correlation and simple linear regression model to real dataset. (CO 3)
10. Testing of hypothesis for large sample tests. (CO 4)
11. Applying the t-test for independent and dependent samples. (CO 4)
12. Testing of hypothesis for Small Sample tests for F-test. (CO4)
13. Applying Chi-square test Contingency test to real dataset. (CO 4)
14. Performing ANOVA for real dataset for one way, two way and three way classifications. (CO 5)

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Text Books:

1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", 3rd Edition, John Wiley and Sons Inc, 2005.
2. Walpole R. E., Myers S.L. and Keying Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education Inc, 2012.

References:

Reference Books:

1. Johnson R. A., Miller and Freund's, "Probability and Statistics for Engineers", 8th Edition, Pearson Education, Delhi, 2015.
2. Devore. J. L., "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, New Delhi, 2014.

Journal References:

1. International journal of probability and statistics:
   http://www.sapub.org/Journal/articles.aspx?journalid=1119
2. International Journal of Experimental Design and Process Optimisation:
   https://www.inderscience.com/jhome.php?jcode=ijedpo

Web Resources:

1. https://www.youtube.com/watch?v=KzfWUEJjG18
2. https://www.youtube.com/watch?v=bpKarwfDRIk
3. https://www.youtube.com/watch?v=32CuxWdOlow
4. https://www.youtube.com/watch?v=zJ8e_wAWUzE
5. https://www.youtube.com/watch?v=iYiOVISWXS4
6. https://www.youtube.com/watch?v=I_dhPETvll8

MOOC/NPTEL/SWAYAM Courses:

1. https://archive.nptel.ac.in/courses/117/105/117105085/
2. https://nptel.ac.in/noc/courses/noc22/SEM1/noc22-ma30/
3. https://onlinecourses.nptel.ac.in/noc22_mg31/

4. Course Outcomes

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23MA209.1	Formulate and solve problems involving random variables.
U23MA209.2	Analyze the basic concepts of random variables and find an appropriate distribution for an experiment.
U23MA209.3	Apply statistical methods like correlation, regression analysis in analyzing, interpreting experimental data.
U23MA209.4	Analyze the concept of various test statistics used in hypothesis testing for mean and variances of large and small samples.
U23MA209.5	Evaluate the factors controlling the value of a parameter through conducting, planning, analysing and interpreting the data.

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U23CB401	Operating Systems	L	T	P	J	C
		3	0	0	0	3

1. Course Description:

This course introduces students to the fundamental principles and concepts underlying modern operating systems. Through lectures, practical exercises, and assignments, students will gain a deep understanding of the design, implementation, and management of operating systems. Topics covered include process management, memory management, file systems, device management, security, and virtualization. Emphasis will be placed on both theoretical concepts and practical applications, with hands-on experience in working with various operating systems.

2. Course Objectives:

1. To understand the core principles and architecture of operating systems, including kernel types and process management.
2. To implement CPU scheduling and synchronization techniques to manage concurrent processes.
3. To analyse and identify appropriate strategies for handling deadlock situations, and to apply advanced memory management techniques effectively.
4. To manage virtual memory and file systems for optimal resource allocation and storage efficiency.
5. To gain expertise in real-time operating systems (RTOS) and virtualization technologies to address modern system challenges.

3. Syllabus: **45 Periods**

Unit – I Kernel and Process Management (9)

Operating System Overview: Objective and Functions-Types of Operating System-Services- Boot Block- Kernel- Microkernel-Monolithic Kernel-Macro Kernel-System Calls Processes: States of Process-Process Control Block (PCB)-Context Switch-Creation and Termination-Inter-process Communication Threads: Introduction-Multithreading Models-Thread Libraries-Threading issues Case Study: Zombie Process and their Prevention-Lottery Process Scheduling

Unit – II CPU Scheduling and Process Synchronization (9)

CPU Scheduling: Scheduling – Scheduling Criteria-Scheduling Algorithms: Pre-emptive and Non-Preemptive Scheduling (FCFS, SJF, LRTF, Round-Robin, Priority)-Process Synchronization: The Critical Section Problem-Peterson's Solution-Synchronization Hardware-Mutex Locks-Semaphores-Classical Problems of Synchronization-Producer Consumer Problem-Dining Philosophers Problem Case Study: Sleeping Barber Problem-Dekker's Algorithm-Bakery Algorithm

Unit– III Deadlock and Memory Management (9)

Deadlocks: Necessary Conditions -Resource Allocation Graph- Deadlock Prevention, Deadlock Avoidance-Banker's Algorithm-Deadlock Detection-Recovery from Deadlock Main Memory Management: Swapping-Contiguous Memory Allocation-Paging- Segmentation-Segmentation with paging Case Study: Snow Cone: Android Memory Management.

Unit- IV Virtual Memory Management and Secondary Storage (9)

Virtual Memory Management: Demand Paging-Page Replacement (FIFO, LRU, Optimal)-Allocation of Frames-Thrashing File Management: Overview-Organization-Access-File Directories-File Structures-File Sharing and Protection-Allocation Methods-Free Space

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Management Mass Storage Structure: Mass Storage System-Disk Structure-Disk Scheduling and Management-Swap Space management-I/O Management and Disk Scheduling Case Study: Buddy Memory Allocation Scheme in Operating Systems

Unit – V RTOS And Virtualization (9)

RTOS: Introduction to real-time systems and OS- RTOS services, real-time tasks- RTOS memory management- Free RTOS Virtualization: Process and System VMs-Taxonomy of VMs -Hardware Emulation-Full Virtualization with binary translation-Hardware assisted -Operating System-Virtualization- Case Study: RTOS for fault Tolerant Applications-Container /Docker

Text Books:

1. Abraham Silberschatz, Peter Bear Galvin and Greg Gagne, "Operating System Concepts", John Willey & Sons (Asia)Pvt ltd, Tenth Edition, 2018.
2. Remzi H. Arpaci - Dusseau, Andrea C. Arpaci – dussea, "Operating Systems: Three Easy Pieces", Amazon Digital Services, First Edition, 2018.
3. Dhanajay M. Dhamdgere, "Operating systems-A Concept Based Approach", Third Edition, Tata McGraw Hill Edition 2019.
4. Smith, Nair, Virtual Machines: Versatile Platforms for Systems and Processes, Morgan Kaufman Publishers, 2005.

References:

Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, Third Edition, 2015.
2. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, Ninth Edition, 2018
3. Charles Crowley, "Operating systems: A Design-Oriented approach", Tata McGraw Hill Education,2017.

MOOC/NPTEL/SWAYAM Course:

1. https://onlinecourses.nptel.ac.in/noc21_cs88/preview.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CB401.1	Analyse the states of a process and explain the role of the Process Control Block.
U23CB401.2	Evaluate CPU Scheduling Algorithms and Implement Synchronization Mechanisms.
U23CB401.3	Design Solutions for Deadlocks and Implement Memory Management Strategies.
U23CB401.4	Apply their understanding of file management concepts, including file directories, structures, and sharing, to real-world scenarios.
U23CB401.5	Apply their understanding of Real-Time Operating Systems and virtualization to real-world scenarios.

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U23AD482	Big Data Analytics	L	T	P	J	C
		2	0	2	0	3

1. Course Description:

This course provides an in-depth exploration of big data analytics, focusing on the tools, techniques, and methodologies used to extract meaningful insights from large and diverse datasets. Through a combination of lectures, hands-on exercises, and real-world case studies, students will develop the skills and knowledge necessary to effectively analyze big data and derive actionable insights for decision-making.

2. Course Objectives:

1. Learn about digital data types, Big Data characteristics, and its role in modern analytics.
2. Grasp the Hadoop ecosystem, its advantages, and challenges in distributed computing.
3. Gain hands-on experience with Pig, Hive, and PySpark for data processing and manipulation.
4. Understand Databricks architecture, features, and optimize data management with Delta Lake.
5. Explore NoSQL data models, distribution, and replication techniques for scalable database solutions.

3. Syllabus: **30+30= 60 Periods**

Unit-I: Fundamentals of Big Data **(6)**

Introduction : Types of Digital Data, Characteristics of Data, evolution of big data, definition and challenges; Why Big Data, Business Intelligence vs Big Data, Coexistence of Big Data and Data Warehouse, Big Data Analytics: Terminologies used in Big Data Environments, CAP Theorem; Introduction to Distributed Computing: Definition, Relation to Computer System Components, A Distributed Program – A Model of Distributed Executions – Models of Communication Networks.

Unit-II: Hadoop Basics **(6)**

Introduction to Hadoop ecosystems: Features of Hadoop, Advantages, Hadoop Distributions, Hadoop vs SQL, Hadoop vs RDBMS, Distributed computing challenges; Hadoop overview: Use case, design of Hadoop distributed file system (HDFS), Processing data with Hadoop, Managing Resources and Applications with Hadoop, YARN, Hadoop Streaming, Hadoop Pipes

Unit-III: Big Data tools **(6)**

Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries. Setting up PySpark environment -PySpark basics- PySpark background - PySpark RDD- Data manipulation-Utility function and Visualizations

Unit-IV: Azure Databricks **(6)**

Introducing Azure Databricks Microsoft Azure Services and Portal Overview: What is Databricks &Why Databricks Databricks Pricing, Infrastructure and Software Charges, Different Cloud Providers offering Databricks Databricks Features Databricks Community Edition, Memory Optimized, Storage Optimized, Compute Optimized, General Purpose, GPU Accelerated Module; Azure Databricks: Databricks File System (DBFS), Databricks Architecture, Control and Data Plane DBFS in detail Object Store, Blob; Delta Lake: Delta Table Creation, Lakehouse Architecture, Azure Delta Engine, Optimizations Delta Architecture, Medallian Architecture Cluster Creation

Unit-V: Working with NoSQL **(6)**

Introduction to NoSQL: Aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication.

List of Experiments: **30 Periods**

1. Installing Hadoop (step by Step) (CO 2)
2. Installing Movie lens dataset Into HDFS using Command line (CO 2)
3. Rank movie by their popularity (Using Map reduce Script) (CO 3)
4. Find the oldest Movie with 5 star rating using Pig (CO 3)
5. Use Hive to find the most popular movie (CO 3)

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6. Setting Up Spark on Windows and PySpark (CO 3)
7. Loading Data onto spark RDDs and RDD Operations on data (CO 3)
8. Sampling/Filtering RDDs to Pick-Out Relevant Data Points (CO 3)
9. Splitting Datasets and Creating New Combinations with Set Operations (CO 3, CO 4)
10. Processing Data workflow using Azure Data bricks (CO 4)
11. Performing Data discovery, annotation, and exploration in Azure Data bricks Generating dashboards and visualizations using Azure Data bricks (CO 4, CO 5)

Text Books:

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2015
2. Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011.

References:

Reference Books:

1. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013
2. Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 2011
3. Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce", Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010
4. Eric Sammer, "Hadoop Operations", O'Reilley, 2012

Journals:

1. https://journalofbigdata.springeropen.com/
2. https://www.techscience.com/journal/jbd
3. https://bdataanalytics.biomedcentral.com/
4. https://www.sciencedirect.com/journal/big-data-research

Web Resources:

1. https://www.ibm.com/topics/big-data-analytics
2. https://www.tableau.com/learn/articles/big-data-analytics
3. https://www.coursera.org/in/articles/big-data-analytics
4. https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-big-data-analytics

MOOC/NPTEL/SWAYAM Course:

1. Big Data Computing (https://onlinecourses.nptel.ac.in/noc23_cs112/preview)

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23AD482.1	Apply the introductory knowledge on big data to create basic analytics for a dataset
U23AD482.2	Implement the HDFS commands for a given dataset
U23AD482.3	Apply big data tools to analyse details and present visualizations
U23AD482.4	Implement Azure Databricks for storing, analysing and visualising data
U23AD482.5	Understand the detailed architecture and apply it to define objects, load data, query data and performance tune Column-oriented NoSQL databases

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U23AD483	Artificial Intelligence	L	T	P	J	C
		3	0	2	0	4

1. Course Description:

This course offers a comprehensive exploration of the foundational principles and core concepts in Artificial Intelligence (AI). Beginning with an introduction to the history and applications of AI, the course progressively delves into intelligent agents, problem-solving, search algorithms, and extends to encompass knowledge representation and planning. Through a structured journey, students will delve into the origin of Artificial Intelligence (AI), covering a spectrum of topics crucial for understanding and equipping them with the problem-solving skills essential for the broader field of AI.

2. Course Objectives:

1. To study about structure of agents and the nature of environments
2. To learn the search algorithms of AI in different environments
3. To Learn and apply adversarial search techniques to solve problems in dynamic environments.
4. To study and infer the logical and probabilistic inference mechanisms.
5. To study the knowledge representation and planning algorithms.

3. Syllabus: **45 + 30= 75 Periods**

Unit-I: INTELLIGENT AGENTS **(9)**

Introduction to artificial intelligence; Intelligent agents: agents & environment, concept of rationality, nature of environments, structure of agents.

Case Study: Autonomous Delivery Robots which interact with their surroundings and navigate through dynamic environments to deliver packages.

Unit-II: PROBLEM SOLVING AGENTS **(9)**

Uninformed search strategies, Heuristic search strategies, heuristic functions; Local search and optimization problems, local search in continuous space, search with nondeterministic actions, search in partially observable environments, online search agents and unknown environments.

Case Study: Autonomous vehicle Navigation in Unknown Environments

Unit-III: GAME PLAYING AND CSP **(9)**

Adversarial search: Games, optimal decisions in games, alpha - beta pruning, stochastic games, partially observable games; Constraint satisfaction problems; constraint propagation, backtracking search for CSP, local search for CSP, structure of CSP

Case Study: Artificial intelligence system plays chess to make optimal moves in a partially observable and dynamic environment.

Unit-IV: LOGICAL AGENTS **(9)**

Knowledge-based agents, propositional logic, propositional theorem proving, propositional model checking, agents based on propositional logic; First-order logic: syntax and semantics, knowledge representation and engineering; Inferences in first-order logic: forward chaining, backward chaining, resolution

Case Study: Automated personal assistant to assist users in managing their daily tasks, scheduling, and information retrieval.

Unit-V: KNOWLEDGE REPRESENTATION AND PLANNING **(9)**

Ontological engineering, categories and objects, events, mental objects and modal logic, reasoning systems for categories, reasoning with default information; Classical planning, algorithms for classical planning; time, schedule, and resources analysis, hierarchical planning, planning and acting in non-deterministic domains

Case Study: Autonomous Warehouse Management System (WMS) for efficient planning, scheduling, and resource allocation within a warehouse environment.

List of Experiments: **30 Periods**

1.	Identify and discuss the distinctive features that set PROLOG apart as a declarative programming language. Break down the essential elements, delving into the role of facts, rules, and queries. Examine how these components work together to facilitate logical reasoning. (CO 1)
2.	Imagine a scenario in a computer game where a character needs to navigate through various cities to complete a quest. The goal is to design a Prolog program that solves the Traveling

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	Salesman Problem for the character, finding the optimal route to visit each city exactly once and return to the starting point while minimizing the total distance traveled. The cities in the game are connected by different types of paths, each with its own associated cost. (CO 2)
3.	Imagine you are working on an AI system for an automated chessboard configuration. One of the challenges is placing four queens on a 4x4 chessboard in such a way that no two queens threaten each other. Provide the Prolog code and demonstrate the solution by showing the positions of the queens on the 4x4 grid. (CO 1, CO 2, CO 3)
4.	Assume you are playing the Pac-Man game where the maze is represented as a grid with Pac-Man, ghosts, walls, and empty spaces. Implement Breadth-First Search (BFS) for Pac-Man navigation, considering the presence of ghosts as obstacles in the exploration process. (CO 2)
5.	Imagine a Real-Time Strategy game (Age of Empires) where you command a battalion of futuristic units navigating a dynamic battlefield. The terrain is diverse, including open fields, mountains, and urban areas. Your mission is to implement the A* search algorithm for unit path finding, considering the real-time movements of enemy units and dynamically changing obstacles. Describe how you would model the game environment as a grid, incorporating varying traversal costs for different terrains. Discuss the heuristic function you would employ to guide unit movements, considering factors such as the proximity of enemies, defensive structures, and the goal of reaching specific objectives on the map. (CO2, CO 3)
6.	Implement the Alpha-Beta Pruning algorithm to determine the best move for a player in a Tic-Tac-Toe game tree. The game tree must represent all possible moves and countermoves, creating an extensive search space. (CO 3)
7.	Consider a scenario where you are developing an AI-driven robotic system for package delivery in a city. The challenge is to evolve the optimal set of parameters that enable the robotic fleet to navigate efficiently through urban environments, considering factors such as traffic, pedestrian density, and delivery deadlines. Design a genetic algorithm to evolve the optimal parameters for route planning and execution in the robotic package delivery system. Describe the genetic operators (crossover and mutation) you would implement in your genetic algorithm. How do these operators enable the exploration and exploitation of the solution space, and how are they tailored to the specific challenges of route planning in urban environments? (CO 2, CO 3, CO 4)
8.	In a telecommunications company, the network infrastructure team is faced with the challenge of optimizing the design of their communication network. The team has decided to apply Simulated Annealing to address this complex optimization problem. The goal is to create an efficient layout of network nodes and connections that minimizes latency, maximizes data throughput, and ensures resource utilization is optimized. (CO 2, CO 4)
9.	Imagine a smart home automation system that utilizes sensors and actuators to control various devices in a household. The system is equipped with motion sensors, door/window sensors, and temperature sensors. Implement propositional logic inferences to make decisions and take actions based on the information gathered by these sensors. The system need to adapt for handling dynamic situations like sudden drop in temperature, changes in occupancy patterns, or the introduction of new devices. (CO 4)
10.	Design a knowledge base for the medical diagnosis system, including predicates representing symptoms, diseases, and treatments. Create classes or functions to represent predicates, clauses, and resolution-based inference operations. Formulate resolution-based inference rules for diagnosing diseases based on reported symptoms and recommending treatments for diagnosed diseases. (CO 5)

Text Books:

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.
2. Elaine Rich and Kevin Knight,"Artificial Intelligence", Tata McGraw Hill Publishing Company, New Delhi, 2014.

References:

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Reference Books:

1. I. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2015.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education, New Delhi, 2017

Journals:

1. Journal of Artificial Intelligence Research (JAIR) - https://www.jair.org/index.php/jair
2. Artificial Intelligence - https://www.techscience.com/journal/jai
3. Journal of Artificial Intelligence in Education - https://link.springer.com/journal/40593

Web Resources:

1. https://www.youtube.com/watch?v=4jmsHaJ7xEA&list=PL9ooVrP1hQOGHNaCT7_fwe9AabjZI1RjI&index=1
2. https://www.youtube.com/watch?v=8Pyy2d3SZuM&list=PLEiEAq2VkUULyr_ftxpHB6DumOq1Zz2hq&index=2

MOOC/NPTEL/SWAYAM Courses:

1. https://onlinecourses.nptel.ac.in/noc20_cs81/preview
2. https://www.udemy.com/course/searching-algorithms-in-ai/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23AD483.1	Implement a study of agents' structures and diverse environments in AI.
U23AD483.2	Apply various AI search algorithms for different environmental scenarios using the knowledge and skills acquired.
U23AD483.3	Implement a comprehensive study of adversarial search techniques and resolving constraint satisfaction problems in AI.
U23AD483.4	Apply logical and probabilistic inference mechanisms to improve decision-making in AI systems.
U23AD483.5	Analyze knowledge representation techniques and planning algorithms vital for Artificial Intelligence

U23NCC02	NCC Credit Course Level II	L	T	P	J	C
		2	0	2	0	3

1. Course Description:

NCC Course Level II designed by UGC as a general elective course, equips students with essential skills for emergency response, fieldwork, and military activities. Students acquire expertise in disaster management, including coordinating relief efforts and managing various disaster scenarios. They also enhance their communication and navigation skills, mastering map reading and compass usage. This course provides a foundational understanding of the Armed Forces while advancing the field and battle skills of students. Overall, cadets enhance their physical fitness, agility, and discipline through rigorous training, culminating in a remarkable improvement in their overall agility and readiness.

2. Course Objectives:

1. Equip students with the necessary skills to maintain health and safety standards, respond effectively to medical emergencies, and manage patient care during crises
2. Instruct students in the principles of disaster management, enabling them to respond effectively to emergencies, collaborate with relevant authorities, and support relief efforts.

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3. Develop students' proficiency in communication and map reading, including interpreting various map features, using navigation tools, and understanding geographic orientation.
4. Educate students on the structure and roles of the armed forces, pathways for entry, and the significance of military honors and awards.
5. Train students in essential field and battle craft skills, focusing on distance estimation, terrain analysis, camouflage, and effective communication

3. Syllabus: **30 + 30 = 60 Periods**

Unit-I: Health & Hygiene **(6)**

Hygiene & Sanitation, Cleanliness, Water supply and its purification, Physical and Mental Health, First Aid: Common Medical Emergencies, Dressing of Wounds, Fracture & Treatment, Evacuation of Casualties, Methods of Carrying a Patient.

Unit-II: Disaster Management **(6)**

Civil Defence Organizations, Natural Disaster Management Authority (NDMA), National Disaster Responsive Force (NDRF), Types of Disaster, Fire Fighting, Traffic Control, Methods of NCC Assistance, Relief Camp, Collection & Distribution of Aid Material

Unit-III: Communication & Map Reading **(6)**

Communication, Introduction to types of maps & conventional signs, Scales & Grid System, Relief, Contours & Gradients, Cardinal points & Types of North, Types of Bearing, Service Protractor, Prismatic Compass.

Unit-IV: Armed Forces **(6)**

Basic organization of Armed forces & Army, Modes of Entry to Army, Honours & Awards, Concept of Integrated Defence staff.

Unit-V: Field Craft & Battle Craft **(6)**

Introduction to FC&BC, Judging Distance, Description of ground, Observation camouflage & concealment, Field Signal, Section Formation, Fire Control Orders, Fire & Movement.

List of experiments: **(30)**

1. Evaluate basic drill exercises to enhance discipline, coordination, and teamwork among cadets
2. Provide cadets with basic weapon handling skills, safety procedures, and marksmanship fundamentals.
3. Analyse the basics of map reading, including understanding map symbols, using a compass, and determining coordinates, to enhance their navigation skills.
4. Demonstrate the fundamentals of firing, including safety procedures, weapon handling, and marksmanship, to enhance their shooting skills and discipline.
5. Enhance physical fitness, agility, and confidence among cadets by training them to overcome various obstacles training

Text Book:

1. National Cadet Corps “Cadets Hand Book – Army (Common Subjects)”.

Web Reference:

1. https://indiancc.nic.in/

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23NCC02.1	Evaluate various health and hygiene practices, including first aid techniques, to optimize community health and emergency response efforts and develop effective disaster management plans.
U23NCC02.2	Analyze the organizational structure and operational strategies of Civil Defence Organizations and the strategic plans for career entry into the Armed Forces
U23NCC02.3	Understand the advanced map reading and communication skills to accurately interpret navigational tools
U23NCC02.4	Demonstrate teamwork strategies and physical training through advanced drills and obstacle courses, enhancing coordination and discipline.
U23NCC02.5	Analyse and implement advanced techniques in weapon handling, safety, and navigation,

#NCC Credit Course is offered for NCC Students Only

U23CS492	Full Stack Development	L	T	P	J	C
		2	0	2	2	4

1. Course Description:

This is a comprehensive course designed to equip students with the knowledge and skills required to become proficient full stack developers. The course covers essential front-end and back-end technologies, including HTML5, CSS3, JavaScript, React.js, Node.js with Express.js, Spring Boot backend framework, and fundamentals of MongoDB. Through a combination of theoretical lectures, hands-on coding exercises, and real-world examples, students will gain a deep understanding of each technology's role in the development process and how they work together to build modern web applications

2. Course Objectives:

1. To empower students to design, develop, and deploy dynamic web applications using HTML5, CSS3, and JavaScript
2. To introduce students to build fast, scalable, and maintainable front-end applications using ReactJS
3. To familiarize students with the skills to effectively use MongoDB to build robust, scalable, and data-driven applications
4. To acquaint students to build scalable and efficient web applications using Node.js and Express.js
5. To equip students with the skills to master Spring Boot's core features

3. Syllabus: **30+30+30=90 Periods**

Unit-I: HTML5, CSS3 and JavaScript **(6)**

Full Stack Application: component; HTML5: tags, attributes, properties, importance of semantic HTML, classes; CSS3: CSS3 syntax, properties, borders, text, image, grid layout, media queries, animations; Types of CSS frameworks- Tailwind CSS; Overview of JavaScript: advanced working with functions; JavaScript namespaces; Prototypes; Error handling; Modules in JavaScript; Chaining JavaScript methods; Promises.

Case Study: Website design for an automobile industry

Unit-II: Reactjs **(6)**

ReactJS: library, directory; React components: types of Components, component composition, component styling, adding styles, component intercommunication, data sharing, routing; Hooks:

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states, hooks vs states, types of Hooks; Redux: state container for react apps; React bootstrap: props, router.

Case Study: Portfolio development with authentication.

Unit-III: MongoDB **(6)**

MongoDB: features, environment; Data modelling: Schema creation using mongoose(ODM), create database, data types, drop database; Collection: insert, query, update and delete; Projection: limiting records, sorting records, indexing and aggregation.

Case Study: Design of a simple search engine.

Unit-IV: Nodejs and Expressjs **(6)**

Tech Stack Comparison; NodeJS: node module system, Node Package Manager (NPM); ExpressJs: building RESTful API's; Advanced topics: asynchronous JavaScript, CRUD operations using mongoose, mongo data validation, mongoose modeling relationships between connected data, authentication, authorization, and deployment.

Case Study: QR Code Generator application

Unit-V: Spring Boot **(6)**

Spring Boot: configuration, spring data JPA, create spring data repositories for JPA, web application with Spring Boot, RESTful controllers, message converters, WAR / JAR deployment, creating a RESTful application, HTTP GET, PUT, POST, DELETE.

Case Study: real time message transfer application.

List of Experiments: **30 Periods**

1. Develop a music streaming web application to provide users with a seamless and interactive music listening experience. Users should be able to discover, play, and share their favourite music in real-time. The application should support multiple features such as user authentication, personalized playlists, real-time updates on trending tracks, and social sharing capabilities (CO1,CO2,CO3,CO4,CO5)
2. Build a video conferencing web application that facilitates seamless communication between individuals or groups through high-quality video and audio interactions and supports real-time features, user authentication, screen sharing to enhance the overall video conferencing experience(CO1,CO2,CO3,CO4,CO5)
3. Develop a dynamic and engaging social media platform web application that connects users globally. The platform aims to provide a seamless and real-time social experience, allowing users to connect, share content, and interact with each other and should incorporate features such as user profiles, real-time feed updates, multimedia content sharing, instant messaging, and community building(CO1,CO2,CO3,CO4,CO5)
4. Create a web application that constitutes a dynamic Content Management System (CMS) tailored for blogging that allows users to effortlessly create, manage, and share blog content and provides an intuitive interface, support multimedia content, and facilitate collaboration among multiple authors(CO1,CO2,CO3,CO4,CO5)
5. Build a web application designed to serve as a real-time Project Management Dashboard to streamline project management processes, enhance collaboration, and provide stakeholders with a dynamic and comprehensive view of project progress. The application should offer real-time updates, intuitive navigation, and advanced project tracking features. (CO1,CO2,CO3,CO4,CO5)
6. Design a web application to perform real-time analytics for data-driven decision-making. This web application aims to empower users to analyze, visualize, and derive insights from streaming data that will be suitable for industries requiring instantaneous data processing, such as finance, e-commerce environments(CO1,CO2,CO3,CO4,CO5)

7. Develop a web application designed to revolutionize the job search process to provide job seekers with real-time access to a diverse range of job opportunities, personalized recommendations, and interactive tools to streamline the entire job searching experience(CO1,CO2,CO3,CO4,CO5)
8. To develop an online crowdfunding web application to facilitate real-time creative financing for innovative projects. which acts as a catalyst for novel ideas by providing a dynamic platform where creators can present their visions, attract support, and turn aspirations into tangible achievements(CO1,CO2,CO3,CO4,CO5)
9. Build a To-Do List web application elevates the task management experience through real-time collaboration and user authentication. This application provides users with an intuitive platform for creating, organizing, and collaborating on to-do lists in real-time, ensuring secure access and personalized task management(CO1,CO2,CO3,CO4,CO5)
10. Develop a chat web application to facilitate real-time communication and collaboration. The web application aims to provide users with a seamless and interactive platform for one-on-one and group chats, ensuring instant messaging, multimedia sharing, and a user-friendly experience(CO1,CO2,CO3,CO4,CO5)
11. Develop a comprehensive web application to empower users with a real-time expense tracking system for efficient money management that constitutes users with a user-friendly interface, real-time financial insights, and personalized budgeting features to help them make informed financial decisions and achieve their financial goals(CO1,CO2,CO3,CO4,CO5)
12. Design a gaming web application that offers a real-time multiplayer gaming experience to provide users with a diverse range of games, interactive features, and a social gaming environment, allowing players to connect, compete, and collaborate in real-time(CO1,CO2,CO3,CO4,CO5)

Projects: **30 Periods**

Develop a project for any of the above use cases using MERN stack

Text Books:

1. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019
2. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018

References:

1. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018.
2. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018.

Web Resources:

1. https://www.tutorialspoint.com/the-full-stack-web-development/index.asp
2. https://www.youtube.com/playlist?list=PL9ooVrP1hQOGTHk2auXsk3cyqRBbbsQ6l
3. https://www.freecodecamp.org/news/learn-web-development-free-full-stack-developer-courses-for-beginners/

Online Course:

1. https://www.udemy.com/course/ultimate-web/?couponCode=SKILLS4SALEB
2. https://www.coursera.org/professional-certificates/ibm-full-stack-cloud-developer

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CS492.1	Build dynamically enriched web pages with HTML5, CSS3, and JavaScript
U23CS492.2	Implement data handling and fetching in React applications using state management libraries
U23CS492.3	Develop a web application with MongoDB as the backend
U23CS492.4	Develop ExpressJS applications that define routes and handle HTTP requests and responses
U23CS492.5	Develop RESTful APIs with Spring Boot for resource representation, HTTP methods and error handling

U23CB451	Operating Systems Laboratory	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

The Operating Systems Laboratory complements the theoretical concepts learned in the Operating Systems course by providing hands-on experience with operating system principles and practices. Through a series of guided exercises and projects, students will gain practical skills in operating system design, implementation, and management. This laboratory course focuses on reinforcing key concepts through experimentation, troubleshooting, and real-world application.

2. Course Objectives:

1. To understand and implement Linux Commands.
2. To develop Shell Scripts for System Tasks.
3. To implement and analyse System Calls and Deadlock avoidance algorithm.
4. To design and solve Synchronization and Scheduling Problems.
5. To build and test components of an OS Kernel.

3. List of Experiments: **30 Periods**

1. LINUX Commands. (CO 1)

   man, touch, cat, mkdir, rm, rmdir, ls, cd, cp, mv, pwd, bc, head, tail, wc, rev, who, echo, finger, find, awk, more, paste, bg, fg

2. Shell Programming (CO 2)

   Operators and decision-making statements for pattern generation, simulating arithmetic calculator, and printing number series

3. System Calls (CO 3)

   a) Process Management: fork, exec, getpid, exit, wait, close, stat, system

   b) Inter process Communication: pipe, mkfifo, create, write, read, open, seek, close

4. Demonstrate the Creation of Zombie and Orphan Processes (CO 3)
5. Implementation of Threading & Synchronization Applications (CO 4)
6. CPU Scheduling (CO 4)

   First Come First Serve, Shortest Job First, Priority and Round-Robin Scheduling Algorithm

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7. Process Synchronization (CO 4)
   a) Dining Philosophers' Problem using Semaphore
   b) Producer Consumer Problem using Semaphore
8. Deadlock Avoidance (CO 3)
   a) Banker's Algorithm
9. Linux Kernel (CO 5)
   Configuration, compilation, and rebooting from the newly compiled kernel
10. File Allocation Strategies (CO 5)
   a) Sequential
   b) Indexed
   c) Linked
11. Project (CO 5)
   Build the parts of an OS kernel by using teaching packages such as Nachos and Pintos.

References:

Reference Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons (Asia) Pvt. Ltd, Ninth Edition, 2018.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, Third Edition, 2015.
3. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, Ninth Edition, 2018.
4. Achyut S. Godbole, Atul Kahate, - "Operating Systems", McGraw Hill Education, 2016.

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23CB451.1	Demonstrate the ability to identify, define, and analyze complex problems using appropriate commands, System calls and programming
U23CB451.2	Create solutions and execute them utilizing appropriate programming platforms.
U23CB451.3	Choosing appropriate operating systems in virtualized environments to execute various applications
U23CB451.4	Evaluate the advantages and disadvantages of different design options and consider the associated issues when designing operating systems.
U23CB451.5	Acquire practical understanding of the interaction between programming languages, operating systems, architecture, and effectively utilize them.

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U23EM753	Advanced Logical Thinking	L	T	P	J	C
		0	0	2	0	1

1. Course Description:

This course aims to develop student's logical thinking skills to an advanced level. Students will explore various techniques and strategies to analyse, evaluate, and synthesize information effectively. Analyzing a situation or problem using a logical approach involves gathering all available information, assessing the facts and efficiently deciding the best course of action. Students strive to understand various topics deeply, enhance their memory skills and build greater understanding. They also apply their ideas effectively and thoroughly analyze any arising issues.

2. Course Objectives:

1. Enhance Critical thinking skills by solving programming logic problems involving permutations and combinations.
2. Enhance the Decision making skills using different Possibilities through Probability
3. To develop the skills to analyze complex problems in Simple Solutions through Time Speed Distance Concept
4. Enhance the strategic thinking for Solving Real life problems using Mathematical Concepts
5. Reinforce the Logical skills through Reasoning Puzzles

3. Syllabus: **30 Periods**

Unit-I: Inductive Reasoning through Permutations & Combination **(6)**

Fundamental Principles of Counting: Permutations & Combination, Number Generation Fundamentals; Digit repeater concepts: All possible ways; Recursion and Backtracking: N step Problems, Chess oriented problems and Case Studies.

Unit-II: Decision Making based on Probability **(6)**

Introduction to Probabilities, Application of Probability; Power of Compounding: Case Studies.

Unit-III: Strategical techniques in Time, Speed and Distance **(6)**

Definition and Basics of Time, Speed and Distance; Relative speed: Problems based on Trains; Effective Speed: Problems based on Boats and Streams; Problems based on Races, Escalator problems; Case Studies.

Unit-IV: The Logical Approach to Mixture and Allegation **(6)**

Introduction to Mixtures: Multi variable mixing, Profit and Loss concept based on mixing; Liquid mixing concepts: Replacement problems and Repetitive iteration problems.

Unit-V: Logical Reasoning **(6)**

Introduction to design of clocks; Formula creation: Speed clock and Slow clock problems; Angle calculation; Calendars design: Concept of odd days, Day of a date and Calendar repetition logic; Data Arrangements; Data Sufficiency; Directions; Number series and Puzzles.

References:

Reference Books:

1. Dr. R S Aggarwal, Quantitative Aptitude, Revised Edition, S.Chand Publishing Company Ltd(s), 2022
2. Arun Sharma, How to prepare for Quantitative Aptitude for the CAT, 10th Edition, Tata McGraw-Hill Publishing Company Ltd, 2022

Online References:

1. https://www.hackerearth.com/

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2.	https://www.geeksforgeeks.org/
3.	https://www.indiabix.com/

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23EM753.1	Develop the ability to use inductive reasoning to solve complex problems involving permutations and combinations.
U23EM753.2	Understand probability theory to make informed decisions under uncertainty.
U23EM753.3	Utilize strategic techniques to solve problems related to time, speed, and distance.
U23EM753.4	Apply logical reasoning to solve problems involving mixtures and allegations.
U23EM753.5	Enhance logical reasoning skills to tackle a variety of analytical problems.

U23AD651	Project with Design Thinking (Product / Software Development Life Cycle)	L	T	P	J	C
		0	0	0	2	1

1. Course Description:

This course integrates design thinking principles into artificial intelligence and data science, fostering innovation and user-centric AI solutions that address critical societal needs. Students will engage in projects from initial ideation (TRL 1) to functional AI prototypes (TRL 6), focusing on solving challenges in alignment with Sustainable Development Goals such as Good Health and Well-being (SDG 3) and Sustainable Cities and Communities (SDG 11). By employing empathic design, iterative prototyping, and AI-driven insights, students will collaborate to create intelligent systems that enhance societal well-being and sustainability. The course encourages students to design, test, and refine AI models and data-driven solutions that are impactful, ethical, and aligned with global sustainability initiatives.

2. Course Objectives:

1. Identify current problems in Artificial Intelligence and Data Science through literature survey.
2. Design and analyze solutions for identified problems using modern engineering tools.
3. Create innovative methodologies and develop working models to solve existing problems.
4. Apply appropriate software development methods to implement and deploy solutions.
5. Evaluate teamwork's role in project execution and estimate financial requirements for project success.

3. Guidelines: **30 Periods**

The student identifies the problems in the artificial intelligence and data science field by conducting a literature or industry survey. After that, the student finds the solution to solve those problems by applying modern engineering tools. Continuous review will be conducted based on approved rubrics to ensure ongoing progress and quality. After finding the solution, the student develops the working model, design, or simulation for evaluation. Each student shall finally submit a report covering background information, literature survey, problem statement, methodology, and use of modern tools within the stipulated date. Every project work must be guided by the institute faculty members.

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4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23AD651.1	Identify the problems in artificial intelligence and data science field by literature survey.
U23AD651.2	Design, analyze and solve the identified problems by using modern engineering tools
U23AD651.3	Create innovative methodologies to solve the existing problems and developing the working models.
U23AD651.4	Apply appropriate software development methods, to implement and deploy solutions for the artificial intelligence and data science related problems.
U23AD651.5	Implement the role of team work in a project to find the solution and estimate the financial requirement of a project.

U23MC903	Environmental Science	L	T	P	J	C
		1	0	0	0	NC

1. Course Description:

Environmental Science for Engineering Students offers a focused exploration of key environmental concepts tailored to the needs and interests of engineering students. This course provides a comprehensive understanding of environmental issues relevant to engineering practice, emphasizing the application of scientific principles and engineering solutions to address environmental challenges. Students will develop the knowledge, skills, and perspectives necessary to integrate environmental considerations into engineering design, planning, and decision-making processes.

2. Course Objectives:

1. To impart knowledge on the principle of environmental science and engineering.
2. To make students understand the ecosystems and natural resources.
3. To enable students understand the various causes for environmental degradation.
4. To create awareness on pollution, value education, population growth and social issues.
5. To enhance the current opportunities in sustainability and its solution in environmental aspects.

3. Syllabus: **15 Periods**

Unit-I: ENVIRONMENT AND ECOSYSTEM (3)

Scope and importance; concept of sustainability and sustainable development: concept of an ecosystem, structure and function of an ecosystem; producers, consumers and decomposers; Energy flow in the ecosystem, food chains and food webs.

Unit-II: ENVIRONMENTAL POLLUTION AND ANALYSIS (3)

Environmental pollution: types, causes, effects and controls, Air, Water, soil and noise Pollution, Role of individual in control of pollution; Nuclear hazards and human health risks.

Unit-III: NATURAL RESOURCES (3)

Land resources and land use change: Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations; Water: Use and over-exploitation of surface and ground water.

Unit-IV: SOCIAL ISSUES AND ENVIRONMENTAL POLICES (3)

Environmental Issues; Environmental ethics; Climate change: global warming, ozone layer depletion and acid rain; Environment Laws: Environment Protection Act, Air (Prevention & Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.

Unit-V: HUMAN POPULATION AND THE ENVIRONMENT (3)

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Population growth: variation among nations, Population explosion, Family Welfare Programmes; Environment and human health: Human Rights, Value Education; Women and Child Welfare; Role of Information Technology in Environment and Human Health.

Text Books:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Pearson Education, 2004.
2. Dr. A. Ravikrishnan, Environmental Science and Engineering, Sri Krishna Hi-Tech Publishing Company Pvt. Ltd., 10th Edition, 2014.
3. M. Davis, S. Masten, Principles of Environmental Engineering and Science, Mcgraw hill publisher, 3rd Edition, 2013.
4. G.M. Masters, W. Ela, Introduction to Environment Engineering and Science, Prentice Hall Publisher, 2008.

References:

Reference Books:

1. R. K. Trivedy and P. K. Goel, An Introduction to Air Pollution, BS Publications, 2003.
2. G. Tyler Miller and Scott E. Spoolman, Environmental Science, 15th Edition, Cengagelearning, 2016.
3. Miller T. G. and Spoolman S. E., "Environmental Science", Cengagelearning16th Edition, 2017.
4. Sinha J., "Environmental Science", Galgotia Publications, 2nd Edition, 2011.
5. P. J. Vesilind, J. J. Peirce, R.F. Weiner, Environmental Pollution and Control. Butterworth-Heinemann, USA, 1990.
6. S. Divan, A. Rosencranz, Environmental Law and Policy in India: Cases, Materials and Statues (2nd edition). Oxford University Press, 2002.

Journals:

1. RSC Advances (https://pubs.rsc.org/en/content/articlehtml/2012/ra/c2ra20340e)
2. International journal of Hydrogen Energy (https://www.sciencedirect.com/science/article/abs/pii/S0360319916309478)
3. Nano Energy journal (https://www.sciencedirect.com/science/article/abs/pii/S2211285518305755)
4. International Journal of Electrochemical Science. (http://www.electrochemsci.org/papers/vol11/111210628.pdf)

Video References:

1. https://www.youtube.com/watch?v=Y5B1nWYle40
2. https://study.com/academy/lesson/what-is-environmental-science-definition-and-scope-of-the-field.html
3. https://www.youtube.com/watch?v=CXCT2R1K6Ts
4. https://www.youtube.com/watch?v=89B9IT0Tl-Q
5. https://www.youtube.com/watch?v=p-lSPDDdVtc

MOOC/SWAYAM/NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. https://onlinecourses.nptel.ac.in/noc19_ge22/preview

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3. https://onlinecourses.nptel.ac.in/noc20_ge16/preview

4. Course Outcomes:

After successful completion of the course, the student should be able to:

CO. No.	Course Outcome
U23MC903.1	Outline the structure and functions of an eco system
U23MC903.2	Categorize the different types of pollution and its preventive measures
U23MC903.3	Interpret the importance of natural resources in environment
U23MC903.4	Identify the social issues and to utilize the environmental policies
U23MC903.5	Apply role of IT in human population and environment

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